COMMODITY DERIVATIVES AND RISK MANAGEMENT-A STUDY OF FUTURES COMMODITIES

THESIS

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Ph. D. (Business Administration)

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DEDICATED WITH EXTREME AFFECTION AND GRATITUDE TO

My parents Mr. Y.Ali Baig and Mrs. Khair Unissa Begum

My husband M.A.Moiz

My Kids Hasnain, Ehsan, Saboor

And

My research Supervisor prof.Mohammed Khalid Azam

& prof.Badiuddin Ahmed

DECLARATION

I do hereby declare that the thesis **titled "Commodity Derivative and Risk Management-A Study of Futures Commodities"** submitted to the Faculty of Management Studies and Research, Aligarh Muslim University, Aligarh for the award of degree of **Ph.D. in Business Administration** is a record of original work done by me under the guidance of **Prof. Mohammad Khalid Azam**, Department of Business Administration, AMU (Internal Advisor) and **Prof**. **Badiuddin Ahmed**, Maulana Azad National Urdu University, Hyderabad. (External Advisor). It is not previously formed the basis for the award of any Degree /Diploma /Associateship /Fellowship or similar title to any candidate of any university in India.

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CERTIFICATE

This is to certify that the thesis titled **"Commodity Derivatives and Risk Management-A Study of Futures Commodities",** submitted to the Faculty of Management Studies and Research, Aligarh Muslim University in partial fulfillment of the requirements for the award of the degree of **Ph.D. in Business Administration** is a record of original work done by **Ms. Saleha Firdous,** during the period of her study in the Department of Business Administration, Faculty of Management Studies and Research, under my supervision and guidance. This thesis has not formed the basis for the award of any degree, diploma, associateship, fellowship or other similar title to any candidate of any university in India or abroad.

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Chapter: 1 Introduction to Derivatives and Risk Management

Chapter: 1

Introduction to Derivatives and Risk Management

With the opening up of the economy to multinationals, the adaptation of opened economic strategies is determined additional in the direction of the unrestricted market economy. It disclosures the investors to numerous risks such as exchange risk, market risk, interest rate risk, economic risk, political risk and so on. By the incorporation of fiscal markets and unrestricted flexibility of the capital, risk too grew. Pioneering the current national of the economy, there is a crucial need for the investors to shield their interests by flowing some of the uncontrollable financial risks to those who are also to bear and accomplish them. Accordingly, the risk management becomes a must for existence subsequently there is a high volatility in the present financial markets. In this perspective, derivatives occupy an imperative domicile as a risk reducing mechanism. Derivatives are beneficial for falling many of the risks cited above. History of financial markets has evidence to suggest that when risk management avenues are provided by means of derivatives, markets attract higher volumes of investments from savers, strengthening the markets in the process.

Derivatives are financial instruments whose value depends on the values of some underlying Assets. Such asset could be tangible such as wheat, cotton, real estate or financial instruments like equity or it could be intangible such as interest rates or index. The return on derivatives are derived from those of the assets. In a way, the performance of Derivatives depends on how the underlying assets perform. A derivatives does not have any physical existence but emerges out of a contract between two parties. It does not have any value of its own but its value in turn, depends on the value of other physical assets which are called the underlying assets.

Derivatives plays a range of roles however the foremost vital role is hedging. Involves transfer of market risk-the chance of sustaining losses owing to unforeseen unfavorable worth changes. A derivatives mercantilism permits associate degree investors to change his market risk profile by transferring to counter-party some kind of risk for a worth. Hedging is that the prime reason for the appearance of derivatives and continues to be a big issue driving investors to deal in derivatives. Derivatives product serve the vitally vital economic functions of worth discovery and risk management. The transparency that emerges from their mercantilism mechanism ensures the invention within the underlying market. Further,

they function risk management tools by facilitating the mercantilism of risks and acquire obviate undesirable undertones. To facilitate the event of derivatives market, it's necessary to coach the market participants /investors on the hints of those new age product and their strategic use. During this regards, the role of SEBI, stock exchanges and its member participants is extremely a lot is required. To speed up with inevitable and protracted uncertainty, today's investors should perceive the fundamentals of derivatives. Derivatives function tools for managing risk once used judiciously and cautiously.

Commodity markets are extraordinarily volatile in recent years. Volatility brings risk and probability to traders and investors, and can therefore be examined. There are many reasons, except for changes in offer and economic use, for volatility to occur in trade goods markets. Introduction of latest money innovations, like futures, choices and ETFs (Exchange traded Funds), can have an impact on precious metals volatility. Promoting and buying of gold by the International Monetary Fund (IMF) and central banks may additionally modification volatility. Changes in demand for the product of and trade that uses commodities as associate input may end in fluctuations in prices of commodities. Market participants type entirely different expectations of profitable opportunities, perform cross-market hedging across utterly completely different and classes, method data at utterly different speeds, and build and draw inventories at utterly different levels. These factors contribute to volatility of commodities over time and across markets.

In addition to policy manufacturers and portfolio managers, manufacturers also are inquisitive about this information as a result of precious metals have vital and wide-ranging industrial use in jewellery, medicine, electronic and auto catalytic industries. Quantification of the sure variations in precious metals value changes is key in planning wise risk management ways. The primary organized future market was established in 1875 beneath the aegis of the Mumbai cotton trade association to trade cotton contracts. Derivatives commercialism were then unfold to oilseed jute and food grains. The derivative trading in India but didn't have uninterrupted legal approval by the Second war, i.e., between the 1920 & 1940's.

1.1 Meaning

Futures trading within the organized type had commenced in an exceedingly variety of commodities like – cotton, castor seeds, wheat, silver, gold etc. throughout Second war futures trading is prohibited beneath defense rules. Once independence, the subject of

future trading was placed within the union list, and Forward Contracts (Regulation) Act, 1952 was enacted. Futures commercialism in commodities notably, cotton, oilseeds and bullion, was at its peak throughout this era. However, following the inadequacy in numerous commodities futures trading in most commodities was prohibited in middle – sixties. There was a time once trading was allowable solely two minor commodities, viz, pepper and turmeric

Any product that can be used for commerce or an article of commerce which is treated on an authorized exchange is known as commodity. In short, commodity includes all kinds of goods. A commodity derivative derives its value from an underlying asset which is necessarily a commodity. To understand the commodity derivatives markets, it is necessary to be clear about '**commodities**'. A commodity is defined as "an intermediate good with a standard quality, which can be traded on competitive and liquid global international physical markets" says that in olden days Gold was used as currency especially for Chinese and Hindus cultures and Gold work as an important source of store value.

Commodities, in simple words are any goods that are common and unbranded. Gold, silver, rubber, pepper, jute, wheat, sugar, cotton etc., are some of the common commodities. Commodities Futures' trading…! In India have a long history. The first commodity futures market appeared in 1875. But the new standardized form of trading in the Indian capital market is an attractive package for all the people who earn money through speculation by trading into FUTURES. It is a well-known fact and should be remembered that the trading in commodities through futures' exchanges is merely, "old wine in a new bottle". The trading in commodities was started with the first transaction that took place between two individuals. We can relate this to the ancient method of trading i.e., BARTER SYSTEM. This method faced the initial hiccups due to the problems like: store of value, medium of exchange, deferred payment, measure of wealth etc. This led to the invention of MONEY. As the market started to expand, the problem of scarcity piled up. The farmers / traders then felt the need to protect themselves against the fluctuations in the price for their produce. In the ancient times, the commodities traded were – the Agricultural Produce, which was exposed to higher risk i.e., the natural calamities and had to face the price uncertainty. It was certain that during the scarcity, the farmer, realized higher prices and during the oversupply he had to lose his profitability. On the other hand, the trader had to pay higher price during the scarcity and vice versa. It was at this time that both joined hands and

entered into a contract for the trade i.e., delivery of the produce after the harvest, for a price decided earlier. By this both had reduced the future uncertainty.

One stone still remained unturned- 'surety of honoring the contract on part from either of the parties'. This problem was settled in the year 1848, when a group of traders in Chicago came forward to standardize the trading. They initiated the concept of 'to-arrive' contract and permitted the farmers to lock in the price upfront and deliver the grain at a contracted date later. This trading was carried on a platform called Chicago Board of Trade, one of the most popular commodities trading exchanges' today. It was this time that the trading in commodity futures' picked up and never looked back Although in the 19th century only agricultural produce was traded as a futures contract, but now, the commodities of global or at least domestic importance are being traded over the commodity futures' exchanges. This form of trading has proved useful as a device for Hedging and Speculation. The commodities that are traded today are:

Agro-Based Commodities - Wheat, Corn, Cotton, Oils, Oilseeds etc.

Soft Commodities - Coffee, Cocoa, Sugar etc.

Livestock - Live Cattle, Pork Bellies etc.

Energy - Crude Oil, Natural Gas, Gasoline etc.

Precious Metals - Gold, Silver, Platinum etc.

Other Metals - Nickel, Aluminum, Copper etc**.**

1.2 Concept of Derivatives

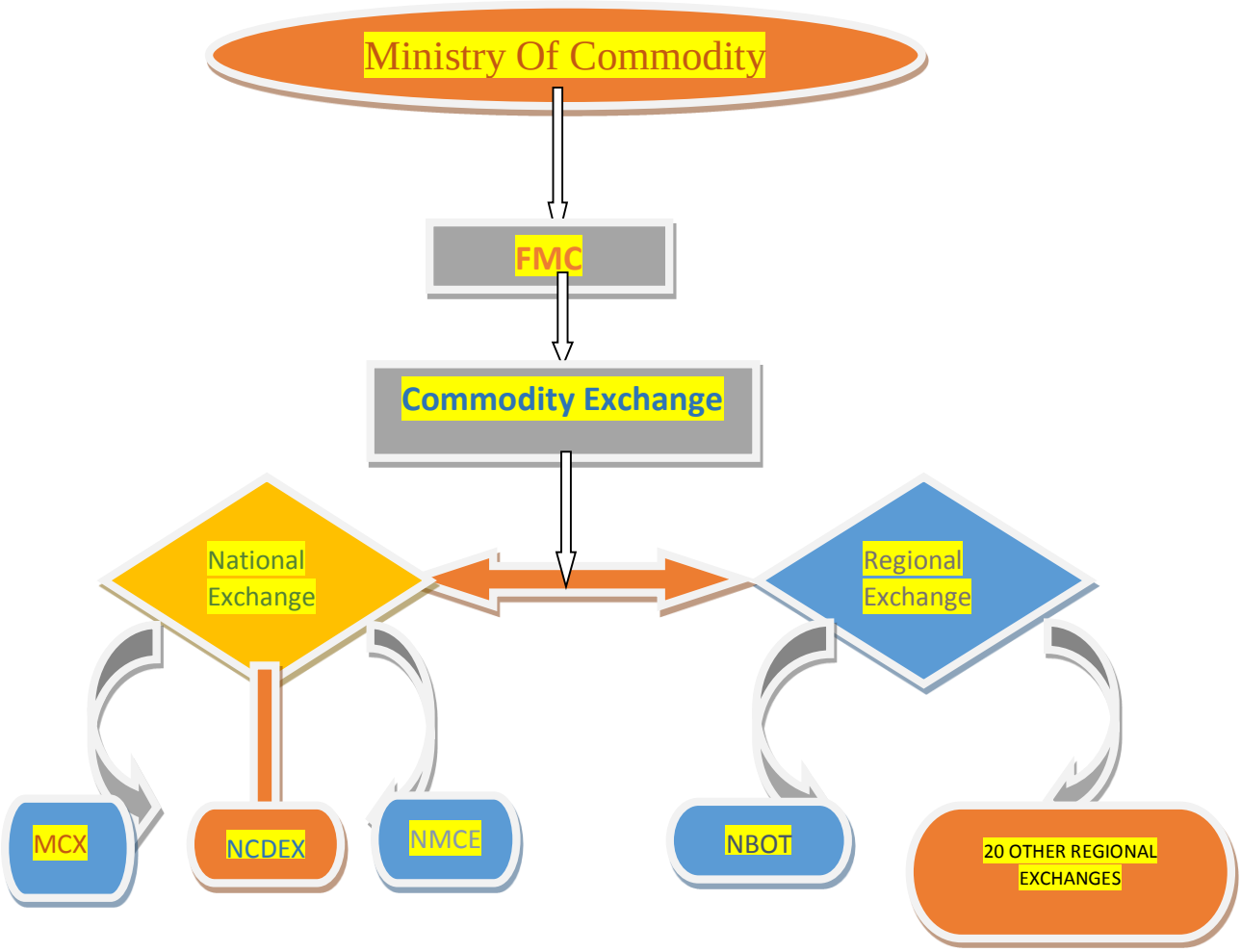
The term 'derivatives, refers to a broad category of monetary instruments that mainly include options and futures. These instruments derive their value from the price and different connected variables of the underlying quality. They are doing not have the price of their own and derive their worth from the claim they furnish to their homeowners to have another money assets or security. A straightforward example of the derivative is butter that is derivative of milk? The value of butter depends upon the price of milk that successively depends upon the demand and supply of milk. The overall definition of derivatives means that to derive one thing from one thing else. Derivatives are: (i) Derived function: the results of mathematical differentiation; the fast modification of 1 quantity relative to another;

df(x)/dx,(ii) derivative instrument: a money instrument whose worth relies on another security, (linguistics) a word that's derived from another word; "`electricity' could be a derivative of 'electric'. The quality underlying a derivative is also trade goods or a money quality. Derivatives are those money instruments that derive their worth from the opposite assets. For instance, the worth of gold to be delivered when 2 months can rely, among such a lot of things, on the current and expected worth of this trade goods.

1.3 Characteristics of Derivatives

1. The transactions in the derivatives are settled by the offsetting/squaring transactions in the same derivatives. The difference is value of the derivatives is cash settled.
2. There is no limit on the number of units transacted in the derivatives market because there is no physical asset to be transacted.
3. The derivatives markets are usually screen-based computerized exchanges as against the trading markets for the physical assets.
4. Derivatives are only secondary market securities and cannot help in raising funds to a firm. In fact, derivatives arise only when the shares and debentures are already issued by the companies.
5. The derivative market is quiet liquid or transactions can be effected easily.
6. The derivatives provide a hedging of a price risk of financial transactions over a certain period. It is a contract to be settled in futures, by cash payment of difference in price. A derivative contract must be distinguished from the underlying asset through the value of the derivative and the underlying as are definitely related.

Figure: 1.1 Structure of the commodity market



1.4 Chronology of Derivative trading in India

Derivatives markets in India have been in existence in one form or the other for a long time. In the area of commodities, the Bombay Cotton Trade Association started futures trading way back in 1875. In 1952, the Government of India banned cash settlement and options trading. Derivatives trading shifted to informal forwards markets. In recent years, government policy has shifted in favor of an increased role of market-based pricing and less suspicious Derivatives trading. The first step towards introduction of financial derivatives trading in India was the promulgation of the Securities Laws (Amendment) Ordinance, 1995. It provided for withdrawal of prohibition on options in securities. The last decade, beginning the year 2000, saw lifting of ban on futures trading in many commodities. Around the same period, national electronic commodity exchanges were also set up. Derivatives trading commenced in India in June 2000 after SEBI granted the final

approval to this effect in May 2001 on the recommendation of L. C Gupta Committee. Securities and Exchange Board of India (SEBI) permitted the derivative segments of two stock exchanges, NSE and BSE, and their clearing house/corporation to commence trading and settlement in approved derivatives contracts. Initially, SEBI approved trading in index futures contracts based on various stock market indices such as, S&P CNX, Nifty and Sensex. Subsequently, index-based trading was permitted in options as well as individual securities. The trading in BSE Sensex options commenced on June 4, 2001 and the trading in options on individual securities commenced in July 2001. Futures contracts on individual stocks were launched in November 2001. The derivatives trading on NSE commenced with S&P CNX Nifty Index futures on June 12, 2000. The trading in index options commenced on June 4, 2001 and trading in options on individual securities commenced on July 2, 2001. Single stock futures were launched on November 9, 2001. The index futures and options contract on NSE are based on S&P CNX. In June 2003, NSE introduced Interest Rate Futures which were subsequently banned due to pricing issue.

Table 1.1: Derivatives in India: A Chronology

Date	Progress
14 December 1995	NSE asked SEBI for permission to trade index futures
18 November 1996	SEBI setup L. C. Gupta Committee to draft a policy framework for index futures.
11 May 1998	L. C. Gupta Committee submitted report.
7 July 1999	RBI gave permission for OTC forward rate agreements (FRAs) and interest rate swaps
24 May 2000	SIMEX chose Nifty for trading futures and options on an Indian index.
25 May 2000	SEBI gave permission to NSE and BSE to do index futures trading.
9 June 2000	Trading of BSE Sensex futures commenced at BSE.
12 June 2000	Trading of Nifty futures commenced at NSE.
31 August 2000	Trading of futures and options on Nifty to commence at SIMEX
June 2001	Trading of Equity Index Options at NSE
July 2001	Trading of Stock Options at NSE
November 9, 2002	Trading of Single Stock futures at BSE
June 2003	Trading of Interest Rate Futures at NSE
September13, 2004	Weekly Options at BSE
January 1, 2008	Trading of Chhota (Mini) Sensex at BSE
January 1, 2008	Trading of Mini Index Futures & Options at NSE
August 29,2008	Trading of Currency Futures at NSE
October 2,2008	Trading of Currency Futures at BSE

Source: Compiled from BSE and NSE

1.5 Risk Management

Everything changes, and changes are often good or bad for those distressed by them. Change thus results in risk, the prospect of gain or loss, and risk something that we have a tendency to should all come back to terms with come back to terms with risk doesn't mean eliminating risk from our lives, that is clearly impossible; nor will it implies that we must always nothing concerning the chance and accepts resulting losses patiently, as if we have a tendency to may have done nothing concerning them. It implies that we have a tendency to should manage risk to simply accept, and on what terms to simply accept them; what new risks to require on; so on. We have a tendency to thus get insurance and be careful before we have a tendency to cross the road, we have a tendency to swallow others, risks, and that we get lottery tickets and speculate on the stock exchange.

Risk arises from the uncertainty regarding an entity's futures losses as well as futures gains. It is not necessarily related to the size of the potential loss, important concerns is the variability of the loss. It includes the sequence of activities aimed to reduce or potential to incur expected losses. Entity can consciously determine how much risk it is willing to take.

1.6 The Risk Management Revolution:

Both the theory and the practice of risk management have developed enormously in the last two and half decades. The theory has developed to the point where risk management is now regarded as a distinct sub-field of the theory of finance, and risk management is increasingly taught as a separate subject .The subject has attracted a huge amount of intellectual energy, not just from finance specialist but also from specialists in other disciplines who are attracted to it. One prominent researcher, Tim Bollerslev, has aptly observed that the finance research now generate an atmosphere of excitement that matches some of the great areas of science, such as the quantum physics research of the 1930s

1.7 Risk management process (George E.Rejda 2011)

1. Identify the risk
2. Quality and estimates the risk exposures or determine appropriate method to transfer the risks
3. Determine collective effects of the risk exposures or performs a cost-benefit analysis on the risk transfers method.

4. Develop a risk mitigation strategy, access performance ad amend risk mitigation strategy as required.

1.8 Risk Management from economy perspective

- Risk management may not be effective on an overall economic basis because it only involves risk transferring by one party and risk assumption by another party.
- Risk must be sufficiently dispersed among willing and able participants in the economy.
- Another challenge with risk management process is that it failed to consistently assist in preventing markets disruptions or preventing financial accounting fraud.
- Risk management can be thought of Zero-sum game in that some "winning" parties will gain at the expense of some "Losing" parties.

1.9 Tools and procedure to measure and manage risk: Quantitative measure

- Value at Risk (VaR) states a certain loss amount and its probability of occurring with the assumptions of Normal Distribution.
- VaR can be potential dangerous whenever attempting to measure risk in non-normal circumstances i.e. left tailed event i.e. large amount of lose. In illiquid positions over a long period of time.
- Economic capital refers to holding sufficient liquid reserves to cover a potential loss.
- Scenario analysis adverse scenario or worst case scenario full magnitude of potential losses. Stress testing is a scenario analysis that examines a financial outcome based on a given "stress" on the equity.

1.10 Enterprise Risk Management (ERM)

- ERM takes an integrative approach within an entire entity.
- ERM considers entity wide risk and tries to integrate risk considerations into key business decisions
- In ERM framework, Board of Directors agree on the specific risk exposure limit.
- Expected loss often be computed in advance.
- Unexpected loss considers how much an entity could lose outside of the normal course of business.
- Correlation risk –unfavorable events happen together.

- The correlation risk drives up the potential losses to unexpected levels.

1.11 Relationship between risk and reward

Some entities have weak risk management and /or risk governance culture, which allows for potential returns to be overstated because they are not adjusted for the risk. Correlation risk may be ignores, which understate overall risk.

1.12 Classification of Risk

I Market Risk

- Interest rate of return
- Equity Price Risk
- Foreign Exchange Risk
- Commodity Risk

II. Credit Risk

- Default Risk
- Bankruptcy Risk
- Downgrade Risk
- Settlement Risk

III. Liquidity Risk

- Funding Liquidity Risk
- Trading Liquidity Risk

IV. Operational Risk

V. Legal and Regulatory Risk

VI. Business Risk

VII. Strategic Risk

VIII. Reputation Risk

I Market Risk: considers how changes in market prices and rates in investment losses. There are four subtypes of Market Risk.

1. Interest Rate of Return(IRR)

a) IRR –If market interest rates rises, the value of the bond will decrease.
b) IRR may also arises from having completely unhedged positions having only partially hedge positions due to underlying transactions that did not fully offset.(basis risk)

2. **Equity Price Risk**

Volatility of stock prices the risk is divided to two parts a) systematic risk

B) Unsystematic risk

3. **Foreign Exchange Risk**: Foreign exchange risk (also called FX risk, rate of exchange risk or currency risk) may be a monetary risk that exists once a monetary group action is denominated during a currency apart from that of the bottom currency of the corporate

4. **Commodity Price Risk:** Price volatility of commodities due to the concentration of specific commodities in the hands of relatively few market participants

II. Credit Risk: Refers to a loss suffered by a party whereby the counter-party fails to meet its financial obligations to the party under the contract. Credit risk is again divided into four types of risk.

a) Default Risk:
b) Bankruptcy Risk: Risk is that the liquidation value of the collateral is insufficient to recover the full loss on default.
c) Downgrade Risk: Creditworthiness
d) Settlement Risk: The position that is losing may simply refuse to pay and fulfill its obligation.

III. Liquidity Risk: Liquidity risk is the risk that a company or bank may be unable to meet short term financial demands. This usually occurs due to the inability to convert a security or hard asset to cash without a loss of capital and/or income in the process.

a) Funding liquidity risk occurs when an entity is unable to pay down or refinance its debts, satisfy any cash obligation to counter-parties, as fund any capital withdrawals.
b) Trading liquid risk is unable to buy or sell a security at the market price due to a temporary inability to find a counterpart, the impact of trading liquidity risk on an entity could include impairments into its abilities to control market risk and to cover any funding short falls.

IV. Operational Risk: Non –financial problem such as inadequate computer systems (technology risk), insufficient internal controls, incompetent management, fraud,

human error, and natural disasters. Difficulty in accurately valuing complicated derivatives transactions added to operational risk.

V. Legal and Regulatory Risk: Regulatory risk is the risk that a change in laws and regulations will materially impact a security, business, sector or market. A change in laws or regulations made by the government or a regulatory body can increase the costs of operating a business, reduce the attractiveness of investment and/or change the competitive landscape. This risk is highly integrated with the Operational and reputation risk.

VI. Business Risk: This type of risk is uncertain regarding the entity income statement such as

a) Revenue and cost uncertain
b) Demand is significantly lower than the cost overruns
c) Testing, production, or shipping delays.

VII. Strategic Risk: this may be thought of within the context of enormous new business investment, that carry a high degree of uncertainty on final success and profitability from the attitude of an entity dynamical its business strategy compared to its competition.

VIII. Reputation Risk: Reputational risk is that the potential loss of the organization's reputational capital. Imagine that the corporate has an account the same as a checking account that they are either filling up or depleting. There are two elements the primary half is general perceived truth good and also the alternative half is general perception that the entity engages in fair dealing and conducts business in an moral manner social networking sites.

1.13 Need of the Study

Derivative related to Bullion metal crude oil energy etc. Is the hot issue in the finance world, It is the major challenge for all the participants in the financial market. Day by day the complexity in managing the fluctuations in the prices of different commodities is getting more complex. Even though there are many tools and techniques available to manage risk, still there is requirement for the sophisticated instruments to manage risk. Derivative instruments are developed as more sophisticated and innovative tools to handle risk. But still there is unfamiliarity about the derivatives markets specially the commodity derivatives.

1.14 Objectives of the Study

To study the Samuelson Hypothesis that the futures price volatility increases as the futures contract approaches its expiration along with open interest and volume traded in 10 commodity futures contracts traded on MCX India; To test the Market efficiency of Futures and Spot markets; causal relation between the Spot and futures prices; Co-integration between the Future and the spot prices

1.15 Significance of the Study

Commodity Futures related to Gold silver and other commodities is the hot issue in the finance world. It is the major challenge for all the participants in the financial market. Day by day the complexity in managing the fluctuations in the prices of gold and silver and other commodities is getting more complex. Even though there are many tools and techniques available to manage risk, still there is requirement for the sophisticated instruments to manage risk.

1.16 Scope of Study

The study mainly focuses on Indian commodity market, its history and latest developments in the country in Commodities market. The study also keeps a bird's eye view on global commodity market and its development. The study vastly covered the aspects of commodity trading, in Futures and Spot contracts based on different statistical approaches Indian context.

1.17 Sources of Data

The secondary data has been collected from authentic websites of MCX. The closing prices of near contract for the Future price and the Spot price of the commodity under observation has been taken. Apart from this various websites, professional magazines reference books newspapers referred journals and seminars. In addition, books on Derivatives written by various authors, periodicals and articles in the newspapers magazines ad reports on Derivatives is also referred.

1.18 Conclusion of the chapter

It can be concluded from the above chapter where the present study is on Commodity Derivative and risk management –a study of futures market. The term 'derivatives, refers to a broad category of monetary instruments that mainly include options and futures. These instruments derive their value from the price and different connected variables of the underlying quality. Derivatives markets in India have been in existence in one form or the other for a long time. Both the theory and the practice of risk management have developed enormously in the last two and half decades. The theory has developed to the point where risk management is now regarded as a distinct sub-field of the theory of finance, and risk management is increasingly taught as a separate subject. The study also keeps a bird's eye view on global commodity market and its development. The study vastly covered the aspects of commodity trading, in Futures and Spot contracts based on different statistical approaches Indian context. Derivative related to Bullion metal crude oil energy etc. is the hot issue in the finance world. It is the major challenge for all the participants in the financial market. In the next chapter the thesis continues with the literature on risk return, market efficiency Samuelson's hypothesis.

Chapter: 2 Review of Literature

Chapter: 2
Review of Literature

This chapter provides a review of the different empirical studies which have been done on the three forms. The chapter is divided into two parts. The first part that details the studies which have been classified under three heads first Samuelson's hypothesis next on risk and investment and finally on Market efficiency. There are several aspects of Futures Commodity Derivatives markets which are researchable. Some of these have attracted attention of both the Indian and foreign markets Investors, researchers, hedgers etc. and remained un-examined. Some of the facets have been researched greatly, while others have attracted scanty attention and efforts. Among the area of research, some general facets of Commodity derivative have received attention. Besides the general features following are the important research aspects of Commodity derivative.

Development of Futures commodity markets in India plays a vital role for the growth of Indian economy, as well as to the different participants such as Investors, speculators, hedgers, clearing houses, regulators to develop trading strategies etc. which will be proved as an asset for the all-round development of the Indian Economy.

Forecasting volatilities over long period of time will help deal with the important aspects such as procurement of resources including raw material, semi-finished material for the factories, industries as well as agricultural purposes.

2.1 Sequence of Review

The literature is classified and presented in the following fashion:

1) Studies having relevance for the present study with special reference to predicting future price volatility in favor and against according to Samuelson's Hypothesis.
2) Studies based on Returns and Investments
3) The various studies on price dynamics for the better control available in the form of Hedging strategies, Market efficiency of Futures and Spot markets.

2.1.1 Studies in Favour and Against the Samuelson's Hypothesis

Samuelson (1965) proposed that the volatility of futures prices increases as the contract approaches its maturity. He was the first to provide the theoretical foundation

for the relationship between the Futures price volatility and Time to maturity which is being popularly known as the Samuelson Hypotheses or else as the Maturity Effect. We can resolve that when there is a long time until the maturity date little is known about the Future price and the Spot price for the underlying commodities assumed that viable forces in the futures market causes Spot and Futures prices to meet towards the termination of contracts. As a result Futures prices will not react significantly to the new information about the underlying goods.

Rutledge (1979) this study considers agricultural commodities like Cocoa, Soybean oil, pale yellow and silver. His work supports the hypothesis for Cocoa and silver, but not for wheat and soy oil. **Anderson (1985)** this study found support for the hypothesis in wheat, oat soybeans, and soy meal futures. His written report consists of 9 commodities and argues that the seasonal effect is the most important factor affecting volatility. He claims that the presumption is not binding where spot prices are Non-Stationary. **Leistikow (1989)** this study found support for the Samuelson Hypothesis in the commodity like soybean crude-oil, nickel etc. Agreeing to his horizon all the commodities under study is accepting the hypothesis that as the volatility of futures prices increases as the contract approaches its maturity. The term of study is from 1985 to 1987.

Boars and Sutcliffe (1990) they have little support to Samuelson's hypothesis for the period for the FTSE stock index futures contracts for 5 years from 1985-1989. **Bessembinder (1993)** tested the impact of both trading volume and open interest on the price volatility of only near month contracted for the crude oil futures. They recover that the trading volume has a significant positive effect on volatility while open interest has significant negative shock. **Herbert (1995)** examined the relationship between the volatility and time to maturity of natural gas futures contracted traded during June 1990 to May 1994 along with volume of trading. He found that volume of trade significantly influences the volatility rather than time to maturity.

Bessembinder et al. (1996) agreeing to the study, they found that the Samuelson hypothesis is more probable to prevail in the markets that exhibits a negative covariance between changes in spot prices and changes in Net carrying costs. **Allen (2000)** studied 12 different financial futures listed at Sydney futures Exchange London International Financial Futures and Options Exchange and Singapore

International Monetary Exchange .Their study finds evidence of Samuelson hypothesis in 10 out of 12 contracts. **Goodwin and Schnepf (2000)** tested the maturing effect of maize and wheat futures traded in US using conditional heteroscedasticity models. In this study, they used, inventory, volume/open interest, growing conditions and seasonality in testing the maturity issue and they reasoned out the maturing effect exist for corn but not for Wheat.

Moosa and Bollen (2001) examined the maturing effect using S&P 500 futures contracts by using intraday data. They establish an absence of maturity effect in S&P 500 futures. **Gracia and Alvarez (2004)** studied the growing effect of IBEX 35 Index futures which is the stock index futures of Spain and they find that Samuelson hypothesis holds true. The terminations of their analysis show that the Index futures exhibits highest volatility till the daytime there is low volatility after this day. In an extensive study covering twenty three lakhs daily prices available for the six thousand eight hundred five futures contracts covering the major International Exchange. **Samuelson (1965)** mentioned that "It is a well-known rule of thumb that nearness to expiration data involves greater variability or riskiness per hour, per day or per month than farness". In other words, Samuelson Hypothesis postulated that futures prices are more volatile with decreasing time to maturity. 'Samuelson hypothesis' is also popularly known as the 'maturity effect'. Numerous empirical studies have been carried out in various commodities (financial and non-financial) to test the Samuelson hypothesis. Some of the commodities showed strong evidence in favor of it, whereas some other showed either contrary or mixed results.

Galloway et al. (1996) documented evidence supporting the Samuelson hypothesis for agricultural commodities futures in the US market. In fact, in one of the extensive study on Samuelson hypothesis, **Bessembinder et al (1996)** finds that Samuelson's hypothesis is more likely to hold for commodity derivatives rather than financial derivatives. Their study involved 11futures contracts on agricultural commodity, metal and financial futures. **Johnson (1998**) examined the relationship between volatility and time to maturity for SPI futures. He found no evidence of the hypothesis in Australian share price index futures.

Board and Sutcliffe (1990) also showed little support to Samuelson's hypothesis for the period from May 1984 to August 1989 for FTSE Stock index futures contract. **Duong and Kalev (2008)** tested the Samuelson's hypothesis for 14 agricultural,

metal, energy and financial futures listed in six futures exchanges. Using intraday data, the study finds strong support for Samuelson's hypothesis for agricultural commodity futures and not for metal and financial futures. Many studies have also been undertaken to test the relation between time to maturity, futures price volatility as well as trading volume and open interest.

Ripple and Moosa (2007) studied the relation between the volatility of futures prices and the maturity of contracts, trading volume, and open interest for NYMEX crude oil futures. They used contract-by-contract analysis and found that trading volume and open interest significantly influence the price volatility and dominate the Samuelson-maturity effect. Using a different modeling approach based on time series method rather than examining single contracts. **Bessembinder et al. (1993)** though India has a long history of commodity derivatives trading, but majority exchanges focused on single commodity like coffee or sugar and with opaque trading practices. With the introduction of national level multi commodity exchanges in 2003, commodity markets have grown leaps and bounds. But the research on Indian commodity market is at nascent stage.

Verma et al (2010) studied the Samuelson's hypothesis for Wheat and Pepper contracts. They analyzed different contract series for Wheat as well as Pepper and find that maturity effect is present in half of the contract series. **Anderson (1985)** tested Samuelson's hypothesis for 9 commodities and argues that the seasonal result is that the most vital issue touching volatility. He argues that the hypothesis isn't valid wherever spot price measure non-stationary. **Shenbagraman (2004**) studied some of the important components connected to non-price variables, which includes open interest, trading volume maturity period, in the stock market for determining the cost of the underlying shares in the cash market. The Present study covers stock option contracts for four months from November 2002 to February 2003 which consist of 77 contracts and 49 trading days. The survey concluded that net open interest is one of the most significant variables in determining the futures spot price which can be further summarized as open interest plays a vital role when compared to trading volume in Indian context. According to **Bhar and Hamori (2005)** the theoretical background of the volume-volatility relationship rests on the supply and demand model, where certain challenging clarifications are able to be identified. Foremost, the mixture-of-distribution hypothesis claims that data dissemination is contemporaneous.

In this paradigm, we thus abide by a positive contemporaneous causality running from volume to volatility, without any inter-temporal effects in either way. As per **Kolb (2006)** the futures market exhibit inherent risk, from the commencement of the contract, it will be really hard to collect prices information about the futures, spot prices, merely as the contracts approaches towards its maturity the rate of information acquisition increases. The survey involves 11 futures contracts on agricultural commodity, metal and financial futures**.**

Following the hypothesis put forward by **Castelino (1981)** based on **Samuelson (1965)** several reasons have been suggested to explain the non-stationarity observed in future prices. Broadly five sources of the volatility on agricultural future markets have been identified in the literature. They are year effect, the calendar month effect, the contract month effect, the maturity effect and trading session effect. In practice, various schemes are several commodities also appear to attract wide speculative trading. One of the reasons for low volumes could be attributed to some of the measures that FMC undertook in the recent period such as daily mark to market margining, time stamping of trades, demutualization for the new exchanges, etc., with a view to promote market integrity and transparency. The exchanges have attributed subsequent fall in the volume of trade with introduction of these measures a study by **Thomas (2003)** reports that major stumbling blocks in the development of derivatives market are the fragmented physical/spot markets.

Supporting this above view, **Lokare (2007)** suggests that national level derivative exchanges cannot be founded on fragmented localized cash markets. Because of fragmentation, prices of major commodities vary widely across *mandis.* These differences arise because of poor grading, differential rates of taxes and levies, and inadequacy of storage facilities. **Burma and Kumar (2010)** studied the Samuelson hypothesis for the Wheat and Pepper contracts. They analyzed different contracts series for the Wheat as well as Pepper contracts and find that maturity effect is present in half of the contract series. **Saurabh and Prabina (2012**) have studied the Samuelson's hypothesis on 8 commodities traded in MCX they tested the volatility dynamics of futures market and the likely source of volatility such as trading volume, open interest and time to maturity and they institute that the volatility series is moreover dependent on trading volume compared to the open interest or Time-To-Maturity.

Hammoudeh (2008) applied univariate GARCH models to investigate the volatility properties of two valuable metals, gold and silver, and one base metal, pig. They set up in the standard univariate GARCH model that gold and silver had almost the same volatility tenacity, while the perseverance was higher for the pro-cyclical copper. **Engle (1987)** has introduced ARCH –Model by extending the ARCH model to permit the conditional variance to be a determinant of the lunar month**.** Whereas in the standard form, ARCH model expresses the conditional variance as a linear mapping of past squired innovations in this new model they hypothesize that, changing conditional variables directly affect the expected return on a portfolio. Their results from utilizing this model to three different data sets of bond yield are quite bright. Consequently, they conclude that the risk preemie are not time invariant; rather they systematically with the agent's perception of underlying uncertainty.

Dustak-Miller (1979) conducted the study along the live cattle futures contract and finds evidence supporting the Samuelson Hypothesis that the volatility of futures price should increase as the futures contract nears its release. According to **Millions (1986)** 10 out of 11 markets in agricultural, financial and metal futures find evidence of the maturity effect. **Galloway (1996)** report provides evidence of the maturity effect in agriculture futures, only not in precious metals and financial Futures.

Beaulieu (1998) conducted study on two equity indices from September 1985 to December 1991 each contract of 3 months has examined the maturity effect, taking into consideration the current spot price and Futures contract price for the study and found that the maturity effect was present as the standard deviation of the footing i.e. The conflict between the current spot price and the cost of a future contract for a particular commodity decreased when the contract approaches its maturity. **Khouryet al. (1993)** studied six agricultural goods futures in Winnipeg commodities exchange in Canada and located that Samuelson hypothesis holds true documented proof supporting the Samuelson hypothesis for agricultural commodities futures within the US market.

In fact, in one in every of the intensive study on Samuelson hypothesis, **Bessembinder et al. (1996)** found that **Samuelson's** hypothesis is a lot of doubtless to carry for commodity derivatives instead of Financial derivatives. Their study concerned eleven futures contracts on agricultural goods, metal and monetary futures. **Nelson (1991)** extended the ARCH framework in society to better distinguish the

behavior of return volatilities**.** Nelson's study is important because of the fact that it extended the ARCH methodology in the new direction, breaking the rigidness of the GARCH specification. The most important contribution was to propose an EARCH model to test the hypothesis that the variance of the return was influenced differently by negative excess returns. His survey found that not merely was the statement true, but also that excess returns were negatively related to stock market variance.

Yang et al. (2001) found spot price volatility of agricultural commodities is positively affected by unexpected total volume. Unusually, this answer is in stigma with the lead-lag relationship between agricultural futures and spot prices. **Patiet al. (2007)** observed that Futures trading volume &volatility move in parallel directions. They too examined the rate of arrival of data measured by trading volume & open interest and stated that they have substantial influence on volatility But they too found that time-to-maturity has a substantial influence on future volatility.

Sanjay et al. (2009) studied the volatility analysis of close to commodity derivatives on the base of empirical findings of three years futures prices of select commodities, Gold, Silver, Copper and found that after 2007 the benchmark is more volatile and the fickle behavior of metal has beaten the benchmark. **Khalifa et al. (2010)** studied and described that variability plays a decisive part in the depth psychology of fiscal securities industries. They estimate different measures of volatility of gold, silver and copper. They see that the return distributions of the three markets are not normal and the diligence of financial time sampling techniques is helpful in obtaining a normal distribution. Using the autoregressive distributed lag approach.

Batten et al. (2010) explained the models the monthly price volatilities of precious metals. They display that although financial variables can explains gold price volatility, they do not appear to be related to the silver price situation. They find that their effects are invariant with the view that precious metals are too distinct to be counted a single asset class or represented by a single index. **Nilanjan (2010)** had tested the efficiency of wheat futures market by seeing whether a future price of wheat can be utilized as reference and the impact of volatility of future prices on physical markets.

Andersen and Bollerslev (1998) studied daily squared returns are unable to capture the intraday price fluctuations, which can be significant. Hence, the volatility

calculated from closing prices will not be representative of the actual price volatility. Hence, realized Volatility, which is calculated from intraday returns, would provide a more honest and more robust estimate of actual price volatility. **Kenyon et al. (1987**) agreed to the study Volatility in and wheat Corn, soybean, are due to seasonal effect. They are of the impression that changes in the information flow are the key role which gets copied in the ripening effect.

2.1.2 Summary of the Literature in Favour and Against Samuelson's Hypothesis

According to the literature review based upon Samuelson's Hypotheses that the volatility of Futures prices increases as the contract approaches its maturity. Samuelson is the first to provide the theoretical foundation for the relationship between the Futures prices volatility and time to maturity which is likewise known as maturity effect. He has concluded that when there is a long time to the maturity date little is known about the Futures prices and the Spot prices to converge towards the expiration of contract, as a result futures prices will not respond significantly to new information about the underlying commodities different commodities are studied by different research in worldwide exchange and worldwide commodities but still there are mixed reaction of Samuelson's hypothesis that the used inventory, volume/open interest, growing conditions and seasonality in testing the maturity effect and they find maturity effect exists. Some researchers are not so in favor In fact, they are against the Samuelson's hypothesis using, inventory, volume/open interest, growing conditions and seasonality in testing the maturity issue and further concluded that the volatility series is moreover dependent on trading volume compared to the open interest or time to maturity.

2.2 Studies on Returns and Investment

Hiller et al (2006) offer a lucid discussion of the insight gathered by considering these three metals. Briefly, they note that silver and gold are the traditional "investment of last resort" while platinum is a precious metal used for manufacturing commitments. **Engle (1982)** researched ARCH model is based on the idea that a natural way to update a variance estimate is to average it with the recent squared of the rate of return from its mean while conventional time series models and econometrics models operate under as past errors leaving the unconditional variance constant. In the application of ARCH model a relatively long lag in the conditional

variance equation is often called for, and to avoid problems with the negative variance parameters a fixed structure is imposed. In the opinion of **Sharman (1986)** the change in gold demand will affect the nominal price of the gold rather than change in physical quantity of gold whereas when there is change in supply curve which will show an effect on the physical quantity of gold rather than on nominal gold prices**. (Jaffe,1989; Chua, et al.1990; Draper et al;2006)** mainly focused on the role of metals in portfolio diversification .They suggested that investment in metals and other commodities help to improve the performance of the stock and Bond performance.

Capie et al. (2005) also show that gold protects investor's wealth against fluctuation in the foreign exchange value of the US dollar. **Kent Horsager et al. (2006)** studied during 2001-2005 and revealed that the cost of natural gas can be reduced through the prudent use of Derivatives when compared to variable prices procurement strategy. Furthermore, all natural gas Derivative strategies considered here offer less procurement cost volatility these results are no guarantee that the use of derivatives will realize similar saving for further periods.

C.Mitchell et.al (2007) found from a 34 year study period support the claim that the investment benefits are considerably larger if the exposure to precious metal is obtained indirectly via an investment in the equities of precious metals firms, rather than directly by purchasing the precious metal as Gold. **Daskalaki (2011)** reported that all precious metals including gold, silver, platinum etc. offer returns of lower correlation with stocks.

Xiaowei Kang (2012) explained about a closer look at the roles of spot and roll return in performance variation overtime they suggested that spot return in the dominant driver of commodity index variations over short–term period, but roll return becomes increasingly important over longer-term horizons. Furthermore, due to the varied nature of commodity markets, there is a significant cross-sectional variation across commodity sectors, which illustrate the importance of sector exposures in driving the risk and return of commodity index investment. **Samagyei et al. (2013)** opined that gold has been long referred as a safe haven assets. In their study they has tested whether other metals offer similar or better Investment opportunities in periods of crisis and they found that other valuable metals, palladium in specific, deal investors greater compensation for their other market losses than gold. Finally, their analysis suggests that copper is the best performing industrial metal in period immediately

after negative bond shocks. **Draper et al. (2006)** examined the investment role of precious metals in financial markets using daily data for gold, platinum, and silver. They display that all three precious metals have low correlations with stock index returns, which suggests that these metals may provide diversification within broad investment portfolios. They also show that all three precious metals have hedging capability for playing the role of not dangerous havens, particularly during periods of irregular stock market volatility.

Conover et al. (2009) present new evidence on the benefits of adding precious metals (gold, silver and platinum) to U.S. equity portfolios. They find that adding a 25% metals allocation to the equities of precious metals firms improves portfolio performance significantly, and that gold relation to platinum and silver has a better stand-alone performance and appears to provide a better hedge against the negative effects of inflationary burdens. They also display that although the aids of adding precious metals to an investment portfolio varied slightly over time, they succeeded during much of the 34-year period. **Jensen et al. (2002)** found that commodity futures substantially enhance portfolio performance for stakeholders, and expression that the profits of addition commodity futures accrue almost exclusively when the Federal Reserve is following a restrictive monetary policy. The investors should gauge monetary conditions to determine the optimal allocation of commodity futures within a portfolio.

Roache (2010) suggested those industrial metals also common with valuable metals and their prices exhibits significant increases following the recent autonomous debt emergency. Therefore, manufacturing metals might also serve as a place of safety in the events of negative economic conditions. **Fremling's (1986)** researched that gold is the excellent store of wealth and higher liquidity, he says that gold demanded for speculative reasons as a result in short run period non-monetary. Gold demand is a function of not only those variables previously outlined but of real interest rates which represents the opportunity cost of gold held and the expected depreciation of the currency relative to Gold.

Baur and Lucey (2010) examine relations between global stocks, bonds and gold returns to gauge gold as a hedge and a harmless shelter. They discover that gold is a hedge beside stocks, on average, and a harmless shelter in risky stock market conditions. Prices of precious metals have been highly volatile in the past, and even

more so recently. The volatile precious metal price environment requires risk quantification. Value at Risk has developed a vital tool within financial markets for quantifying and assessing portfolio market threat, that is, the risk linked with price movements. According to **Baur & Mc Dermott (2010)** the gold in some countries is a safe haven but for many countries does not serve as a safe heaven. Gold is akin to financial commodities in light of its historical role as anchor of the monetary system and its negligible storing costs. Gold is understood as a risk hedge, and gold prices have complex interrelations with the euro/dollar conversation rate, interest rates and oil prices.

Bauer (2013) reports that high prices of Gold can be linked to "fear" skill, i.e. the price of gold rises due to stockholders fear of weak economic performance. **Chang (2009)** examines cross-market trading dynamics in futures contracts written on seemingly unrelated commodities that are consumed by an industry like rubber, palladium and gasoline futures markets. His study concentrates majorly on how commodity and equity markets communicate at an industry level and documents implications for multi-commodity hedging. **Joe foster (2010)** contributed silver like all precious metals, may be used as a hedge against inflation, deflation or devaluation.

The findings of **C. Ciner (2001)** indicate that these two markets that is Gold and Silver should be approached as separate markets and change in Gold and silver ratio should not to be used a predictor of prices in futures and they are not to be treated as substitutes for hedge against similar risk. **Mc Cown et al. (2006)** are of the opinion that gold has the characteristics of a Zero-beta assets that has the ability to hedge against inflation.

According to **Narender L. A (2006)** India has the long history of trading of commodity derivatives and other related derivatives allowed to play the role. He emphasizes that price risk assumes even greater importance in futures with the promotion of free trade and removal of huddle in the world's economy.

In the opinion of **Ahuja (2006)** the market has made enormous progress in terms of technology, transparency and the trading activity. This happened only after the Government protection removed from the number of commodities and market forces allowed to play the role, pricing and price risk management should be left to the market forces rather than trying to achieve there through administration price

mechanism with the promotion of free trade and removed of trade barriers in the world. **Bhattacharya (2007)** has opined that the varied prices of commodities at various mandis arise because of poor grading, differential rates of taxes and levies and inadequacy of storage facilities.

2.2.1 Summary of the Reviews

After going through the literature from National and International researches it can be concluded that there are various avenues which are available in the markets such as Investment in equity markets, Investment in metals ,Investment in bullions, There are mixed reactions of the researchers some are in favor of gold is the best option as it the traditional investment of last resort **(Hiller et al, 2006; Sharman, 1986; Capie et al. 2005)** and many others are supportive to the fact that precious metals plays a vital role. On the contrary the others are of the opinion that adding precious metals (gold, silver and platinum) to different equity portfolios. They find that adding a 25% metals allocation to the equities of precious metals firms improves portfolio performance, the investment role of precious metals in financial markets such as gold, platinum, and silver all three precious metals have low correlations with stock index returns, other metals offer similar or better Investment opportunities in periods of crisis and they found that other valuable metals, palladium in specific, deal investors greater compensation for their other market losses than gold. Lastly, other commodities like copper is also the best performing industrial metal in period. So, it can be concluded that Investment in portfolios can protect the Investors from risk and better return when compared to investment in in only Precious metals.

2.3 Market Efficiency, Price Dynamics, Price Discovery

Brajesh K.et al. (2013) the researcher aim to investigate the short-run as well as long-run market efficiency of Indian commodity futures markets using different asset pricing models. Four agricultural (soybean, corn, castor seed and guar seed) and seven non-agricultural (gold, silver, aluminium, copper, zinc, crude oil and natural gas) commodities have been tested for market efficiency and unbiasedness. As far as long-run efficiency is concerned, the authors find that near month futures prices of most of the commodities are co-integrated with the spot prices. The co-integration relationship is not found for the next to near months futures contracts, where futures trading volume is low. The authors find support for the hypothesis that thinly traded

contracts fail to forecast future spot prices and are inefficient. The unbiasedness hypothesis is rejected for most of the commodities. It is also found that for all commodities, some inefficiency exists in the short run. The authors do not find support of time varying risk premium in Indian commodity market context. According to **Ajay K. C. et al.(2013)** the spot and future prices of both the commodities (guar seed and Chana) are found to have long term relationship, which is supported by the existence of an error correction mechanism called arbitrage, Johansan's co-integration test and GARCH Model. The spot and future prices of both the commodities (guar seed and Chana) are found to have long term association, which is sustained by the presence of an error correction mechanism called arbitrage.

In the opinion of **Abhijit Sen Committee (2008)** reported that though agricultural price inflation accelerated during the post futures period, it does not necessarily mean that this was caused because of futures trading. Single motive for the rushing of price increase in that period was the relatively low agricultural prices, replicating a worldwide recession in commodity prices. According to **Swami (2009)**that with the extinction of bar on commodities, Indian futures market play a dominant role and proves to be the efficient market at the world economy in terms of price risk management and price discovery. In the opinion of **Gopal (2001)** have divided the market into efficient and inefficient market. Efficient market in terms of price risk management and the reasons for inefficiency of other commodity market were found inefficient due to low volume of trading during maturity period and lack of hedger's participation.

In the opinion of **Mc Kenzie (2002)** that the future market is unbiased in the long run and in the short run it is inefficient and price-biased. According to **Solt (1981)** investigate a sample of Gold and silver covering the period 1971 -1979.They examine the working of Gold and Silver markets from the investors point of view and to analyze the price changes for the Gold and Silver to establish if the efficient markets theory can be applied to the markets for these metals and it is concluded that Gold and Silver proves to have an excellent returns over the decade, but at the same time it does not guarantee the similar performance in the future whether it appears to be risky in metal trading.

According to **Janathan H. et al. (2007)** commodities influence a significant portion of the world economy and can be view as the largest non-financial market in the

world. In the recent history India have significant bull market in commodities every 20-30 years. He say that when the low price prevails in the market they cannot hedge their Futures. **Sari et al. (2010)** examine the co-movements and information transmission among the spot prices of precious metals (gold, silver, platinum, etc.,).They find evidence of a weak long-run equilibrium relationship, but strong feedbacks in the short run. They conclude that investors may diversify a portion of the risk by investing in valuable metals, oil, and the euro.

According to **Prashanta Aet al. (2013)** which reveals that the average Futures prices are greater than the average Spot prices due to the fact that the Comdex is a combination of perishable and non-perishable commodities. They have notice that Futures showed the leadership in the markets, with the help of multiple Regression, and with similar results are being shown with Vector Error Correction model and the Granger Causality. Finally they are of the opinion that the market are efficient and availability of Comdex for the trading can enable the market participants to hedge their risk. In the opinion of **Aviral C. (2005)** the Price Discovery in the Black Pepper Market in Kerala, India explored empirically the incidence of price discovery for black Pepper in spot market, the immediate and the first distant future market by using daily data employing the method of co-integration and directed a recurring graphs. The study reveals that price evidence is exposed in the future market and the results in these three markets are tied together in one co-integration relationship, spot and first detached future contract do not react to alarms in the co integrating on by the near future contract adjust to shock in the long run relationships hoarding these three market together.

According to **Tina M. et al. (1997)** investigated the index futures trading and stock return volatility of Mid-cap 400 index futures, study prove to be on the relation between index futures trading and volatility within the equity market via the S&P Midcap 400 stock market index and Midcap 400 index futures. Daily statistics and trading volume data were obtained from separate dates like pre index dates and that's before June 1991,interim dates which incorporates one hundred seventy five trading after June 5,1991 however before 13 February 1992 and post futures which incorporates once 13,1992.To determine changes reciprocally volatility, Skinners methodology was adopted. The analysis indicated that the documentation decreases reciprocally volatility for the Midcap 400 stocks is just a mirrored image of a decrease

reciprocally volatility that affected all medium capitalization stocks. It is found that the changes are seen in the risk and liquidity for the Midcap 400 stocks due to changes in the world's economy to the introduction of Midcap 400 stocks and index futures

In the opinion of **K. Lakshmi (2007)** the researcher discussed about the implications on the grant of permission to the foreign Institutional Investments, Mutual funds and banks in the commodity derivative Markets .She found that participation of these institutions may boost the liquidity and volume of trade in commodity market and they could get more opportunities for their portfolio diversification. According to **Malliaris & Malliaris (2008)** found that the Silver, platinum and palladium trade generally with gold, but their price dynamics are rather different because they do not share the gold status of quasi international currency.

According to **Parabutra (2010)**first Indian to study the price discovery in India, They examines the standard futures contract and mini contracts for the gold prices in Multi commodity stock exchange, they have come to a conclusion that the futures prices of both standard and mini contracts top spot prices. The mini futures contracts justification of price discovery even though the trading volume represents only 2% on the MCX.

In the opinion of **Brajesh K. et al. (2011)** the price discovery function of future market is divided into two first return and volatility spillover between spot and futures of an asset. Secondly international linkages or return and volatility spillover across different futures market across countries. According to their investigations the future markets are restricted to policy related issues. finally they opined that the Indian and world commodity futures market has not been explored adequately and hence there is a case for investigating the linkages of Indian commodity futures markets elsewhere in the world trading the futures contracts on the same underlying.

Kushankur D. et al. (2012) according to the study market has witnessed phenomenal growth in terms of goods on agreement, trade capacity, involvement, are most important realistic distribution. Pepper has been selected as a commodity to explore the price discovery. Some light on existing methods of price discovery mechanism through some perceptive implications from futures to spot prices has been observed in the Indian pepper futures market. Yet, the modification of advances or surprises in the

futures market is relatively faster than that of the spot market. **Sanjay S. et al. (2012)** they studied the price discovery relationship for ten agricultural commodities. Price discovery results are encouraging given the blossoming atmosphere of commodity marketplace in India. Though the market does not seem to be viable. According to **Harwinder P.K et al. (2013)** conducted by them Futures commodity performs two vital functions of the economy i.e. the first function is price discovery and the second important function is risk management. As it is known the futures markets provides liquidity and facilities to hedge future price risk in that way it will protect the interest of the investors it also paves ways for financial leverages to hedgers, speculators and traders. It will further strengthen the growth of the Indian commodity market to face the challenges of globalization.

In the opinion of **Agarwal. N et al. (2013)** commodity future market plays an important role in price discovery. They analyzed how price volatility is measured and arbitrage strategy can be applied in agricultural commodities for managing price risk. According to **G.Geofferey B. et al. (1997)** the main purpose is to examine the behavior of Finland's stock index futures intraday and price movement and to incorporate the observed external behavior in an assessment of the Finnish futures markets in margin setting practices. The study period is 2 May 1988 to 5 December 1994.Two types of intraday futures returns i.e., minimal and minimal and maximal returns with in a day within a day irrespective of the closing price were constructed. The results equations which is estimated for the calculation and the minimal and maximal return shows a close relation between actual and fitted observations. It is found that brokers are in constant touch with the customer's margins to improve Finnish option markets margins and hence improve the viability of the Finnish futures markets.

Rojer C. (1997) valued the Futures market performance Guarantees. This study derived the value of the Futures market performance guarantee and presented estimates of the worth of the exchanges exposure on the close S&P 500 contract throughout October 1987 market crash. This paper used the econometrics model to assess whether or not the likelihood is economically vital or not. It was illustrated the valuation technique by estimating the worth of the exchanges performance guarantee on the close contracts on December S&P 500 Futures contracts in October 1987. Black's option pricing valuation was applied for call option. The result showed that

the implied variances from the November month option, although high by historical standards measure order of magnitude smaller than the G-K estimates. **Pierre G.et al. (2003)** The investigation is about the VaR models relevant for the commodity traders who have long and short trading position in commodity markets the research is about the computation of VaR models for long (brought the commodity) and short (sold as short position) transaction points in commodity markets, as in the first case the risk comes from drop in the price of the commodity and the trader loses money when the price increase and simultaneously on the other Case risk comes from an increase in the price of the commodity and the traders gains money when the price decreases. The tools used by the researchers are skewed students APARCH model which helps in showing the accurate forecast of the single day VaR for long and short positions commodity markets. Risk matrics skewed students ARCH model as an alternative to both the skewed student ARCH. The period of the study varies from 3rd January 1989 to 31st January 2002 that for about 11 years for the metals and for the energy the period varies from 20th may 1987 to 18th march 2002, and for the agricultural commodity the period ranges from 6th January to 31st January 2002.All the data collected from the daily prices of near futures contract. The analysis is concluded as that skewed student APARCH model performs best in all the cases.

According to **Kee-Kong B. et al. (1998)** investigated the profitability and arbitrage by dividing the analysis in to three elements within which initial half revealed arbitrage profit, the second half was examined arbitrage profit based on quotations data and in third half transaction prices were used. This study obtained knowledge from HKFE for Hang Sang Futures index and option contracts for the sample amount from 1 October 1993 to 31 June 1994.The authors compared the results to look at the effectiveness of the approach that evaluated arbitrage chance supported group action value and it takes under consideration the impact of bid- ask value through estimated spread. Results showed that the frequency of mispricing opportunities varies across totally different approaches during a pattern similar to before the share violation square measure the very best for transaction prices, lower for potential transaction prices and therefore the lowest for bid-ask quotations.

In the opinion of **Abhay and Abhyankar (1998)** created an investigation on linear and nonlinear Granger relation. The most purpose of this study was to tie along of Dwyer, Locke and Yu (1996) and explore any the character of the nonlinear of

causative relationship between the index futures and also the money market in U.K. Back and Brock test, Granger Causality test and ARMA model were employed in its empirical analysis as tools to reveal the objectives. The data set consisted of intraday price histories for four FTSE 100 index futures contracts maturing in March 92, June 92, Sept 92 and also the FTSE 100 index recorded minutes by minutes throughout 1992. The FTSE cash index series exhibited high positive automotive vehicle correlation at the primary lag in every amount with statistically important positive autocorrelation up to lag 6 throughout some futures contracts periods. The results of the Granger Causality test supported the multivariate regression index each raw and AR filtered cash index come back indicated that a high degree of contemporaneous correlation between the cash and futures contracts.

Minho Kim, et al. (1999) studied trading prices and price discovery across stock Index futures and money markets. The authors used the impulse response perform to look at how an innovation in one markets transmits across completely different markets. Group action costs on the S&P 500, the NYSE composite and also the MMI futures contracts from January 1986 to Gregorian calendar month 1991 were selected as sample. Johansen Co-integration and Vector Autoregressive techniques were additionally applied because the tools for the analysis. The Trace and largest chemist worth test indicated that there's no Co-integration relationship among the indicator futures series of the S&P 500 N. Y. Stock Exchange index and major markets index. For volt-ampere estimation, results imply that in predicting sudden movements among indicator futures contracts, the S&P index futures has the very best analytical power.

Joshua Turkinton et al. (1999) investigation on price discovery and Causality among the Australian share price futures markets. This study aimed to modify the extend and temporal order of lead lag relationship between share price index futures and conjointly the underlying spot index. The sample data of the study is from 3 Jan 1995 to 21 December 1995 where the sample was drawn every 5 minutes. Simple cost and Carry method, Co-integration test, ARMA model and simple Granger Causality test were used for the analysis of the study. The Causality tests results indicated that bi-directional relation among the variables and researcher that degree index looks to induce an awfully big response among the futures. In the opinion of **Joseph K.et al. (1999)** an empirical analysis on mispricing of index futures contracts and short sales constraints. The authors analyzed the mispricing of the Hong Kong suspend Seng

index futures contracts. Time transaction data of the Hang Seng index futures contracts from 1 April 1993 to 13 Sept 1996 were obtained, minutes by minute's index price and annualized month end dividend yield for the same period Hang Seng index services were employed in the empirical analysis. The empirical results unconcealed that traders establish positions that don't cover all the dealing cost. It is noted that the traders establish positions that don't cover all the transactions cost .Ex-post arbitrage profit suggested that traders establish positions that does not cover all the transaction cost.

According to **Jae H. et al. (1999)** investigated the lead –lag relationship between the spot markets and stock index evidence from Korea. The writers sought to look into the relationship between futures and spot markets, both in terms of yield and volatility utilizing the nearly incited futures markets in Korea. Dynamics Simultaneous Equation Models (SEM) and Vector Auto Regression Models (VAR) were applied in the analysis section of this field. The authors used 10 minutes intraday data from 3rd May 1996 to 16th October 1996 for the KOSPI 200 index. Simultaneous equation model results showed that in the early inception of Korean futures markets, the futures markets lead the office markets by at least 30 minutes. The Wald statistics also indicated the model is well conditioned and there is a substantial kinship between the futures and spot markets. In the opinion of **Brajesh K. et al. (2008)** investigated the dynamic relationship between stock returns trading volume and volatility from the evidence of Indian stock market. This study addressed so far four important issues such as what kind of relationship existed between trading volume and returns? Do trading volume and returns exhibits dynamic relationship? What kind of relationship exists between trading volume and price volatility and does there exists ARCH effect in the stock return. Their data set consisted of all the stocks of the S&PCNX Nifty index for the period of 2000 to 2008. The study investigated the relationship between trading volume and return and dynamic relationship using OLS and VAR modeling approach. Mixed distribution hypothesis also was tested using the GARCH model. Their findings indicated evidence of positive contemporaneous correlation between absolute price changes and trading volume in Indian stock markets.

According to **QingfuLiu et al. (2011)** investigates the irregular characteristics of mean and variance of different Chinese commodity futures within the (THSV) structure with various distribution rules. Daily closing prices of these futures from

January 2000 to December 2010 are acquired from their particular exchanges such as Chinese commodity futures, Shanghai Futures Exchange (SHFE), and the Dalian Commodity Exchange (DCE). The commodities under study are copper, aluminum, and natural rubber and soybeans. To estimate the capabilities of THSV models in volatility predicting, the values-at-risk (VaRs) for together long and short positions in these futures are anticipated and investigated. The student-t distribution, Bayesian MCMC valuation method, Forecasting variance and VaR for long and short positions, Backtesting, futures price series is fashioned by rolling over the closing price of the near contract to maturity and up to the preceding trading day for the period. The results display that positive and negative shocks have irregular effects on the returns, volatilities, and variance of every commodity futures. However, the sizes of these effects tend to vary across futures markets. In terms of the ability of forecasting one-day-advance VaRs for long and short positions, in mean or variance only does not support upgrade performance of the model over standard models for copper, natural rubber, and soybean futures, are good according to THSV-MN model although aluminum futures in the Chinese markets are doing the best for THSV-GE model.

In the opinion of **S. M. Lokarea (2007)** the investigation is all about to test the market efficiency and performance of commodity derivatives in pointing the price risk management. The period of study is from 2002 to 2004 the commodities under study are Cotton, sugar, rubber, metal, Gur, turmeric, pepper, castor seed, gold, silver, metals and oil. As the study progress further it is found that the strongest evidence of co-integration is found in between the spot and futures prices. Whereas Gold, copper, rice, wheat sugar, cotton sesame seeds lead, tin and crude oil followed a co-movement, the commodities such as nickel and sugar (M) having no integration. So, it can be concluded that Indian commodity markets is improving its efficiency, but at a slower rate. In terms of volatility futures prices was substantially lower then spot prices which means inefficient utilization of market information. Several commodities also appears to attract wide speculation trading. Hedging proves to be an effective preposition in respect of some commodities. While other entail moderate or considerably higher risk.

According to **Arouri et al. (2011)** in this article the researcher indiscriminate VAR-GARCH approach to observe the magnitude of volatility spread between oil and stock markets in Europe and the United States at the sector-level. The pragmatic model is

useful in that it typically allows simultaneous shock transmission in the conditional returns and volatilities. In so far as volatility transmission across oil and stock sector markets is a crucial element for portfolio designs and risk management, we also analyze the optimal weights and hedge ratios for oil-stock portfolio holdings with respect to the results. The findings point to the existence of significant volatility spillover between oil and sector stock returns. However, the spillover is usually unidirectional from oil markets to stock markets in Europe, but bidirectional in the United States. Our back-testing procedures, finally, suggest that taking the cross-market volatility spillovers estimated from the VAR-GARCH models often leads to diversification benefits and hedging effectiveness better than those of commonly used multivariate volatility models such as the CCC-GARCH of **Bollerslev (1990)** the diagonal BEKK-GARCH of **Engle and Kroner (1995)** and the DCC-GARCH of According to **Engle (2002); Mamta Jain et al. (2014)** it emphasizes on finding out the relationship between future prices and spot prices of selected agricultural commodity Black Pepper by applying Co-integration test using secondary data of 59 futures contracts for the period of 5 years from June 2008 to May 2013. On the basis of this study, conclusion has been drawn that is a co-integration between future and spot prices of agricultural Commodity Black pepper

In the opinion of **Kannam S. et al. (2013)** the spillover effects between the Asian equity market and the volatility of most dominant commodities such as Gold, Crude oil. The date is collected from the Bloomberg database of 14 countries index and 2 commodities futures for the period of seven year (7 years).The tools used in the study are Bivariate GARCH model from pre-crisis to crisis period which continues from 5th July 2005 to 26th June 2007 and 27th February 2007 to 31st December 2010 respectively. The finds are divided into three portions firstly Gold price volatility dominates the equity markets as it proof the history as wrong because it was the reveres case the Oil price volatility use to dominates the equity markets. Secondly the pre –crisis period suggest that the Oil prices dominates whereas during crisis period Gold is the most dominating commodity. Thirdly out of 14 countries studied it is found that 4 countries shows no spillover effect between oil and equity price volatility whereas other 7 countries shows no spillover effect on Gold and equity price volatility and other remaining 3 countries shows the spillover effect.

According to **Ladislav et al. (2013)** the capital market efficiency .The measures taken into consideration the correlation structure of the return (long term and short term memory) and local herding behavior. The period of study for 11 years that is from 2000-2011.the 41 stock indices are considered for the study. The tools used for the study are efficient market and fractal dimension and capital market efficiency measure. The results are furnished in the following category the researched found the Japanese NIKKEI is the most efficient market from the geographical point of view whereas Venezuelan IBC, Malaysian KLSE, Slovakian SAX,CSE of are proof to be the most inefficient markets. According to **K.G.Sahadevan (2002)** is regarding the derivative market in agricultural commodities markets of India. The survey is simply for the recognized exchanges and Tools ordinary least square (OLS) method for estimation regression equation serial correlation; Cochrane-orcutte chi-square has been used for testing the integration between ready and futures markets only in 1997-98 while daily futures and comparable ready price data were available .The study as mentioned above is based on a visit to seven exchanges. Regarding its trading activities regulative setup etc. to judge the potency of price discovery secondly to know the interrelation between the prices, volume of dealings, open interest and volatility of the market. The conclusion of the researcher is commodity future exchange markets fails to supply the hedge against the danger emerge from volatile prices .Futures markets in commodities don't seem to be economical within the senses that the long runs prices don't seem to be an unbiased prediction of the future ready return .The results indicate that the long run and ready markets don't seem to be integrated .Due to lack of participations of trading members and irregular trading activities, state intervention. Low volume and low market debt etc. so there's ought to target sure aspects on totally different approaches of state, the regulative bodies and also the stock exchanges market in India for the event of the long run markets and vivacious segments for risk management plays a very important role particularly in any dominated economy of India.

In the opinion of **Bessembinder and Seguin (1993)** tested the impact of both trading volume and open interest on price volatility of only near month contracts for crude oil futures. They find that trading volume has a significant positive effect on volatility while open interest has significant negative impact. Though India has a long history of commodity derivatives trading, but majority exchanges focused on single commodity

like coffee or sugar and with opaque trading practices. With the introduction of national level multi commodity exchanges in 2003, commodity markets have grown leaps and bounds. But the research on Indian commodity market is at nascent stage.

According to **Verma and Kumar (2010**) studied the Samuelson's hypothesis for Wheat and Pepper contracts. They analyzed different contract series for Wheat as well as Pepper and find that maturity effect is present in half of the contract. In the opinion of **Bryant, H.L.et al. (2006)** tested causal hypotheses emanating from theories of futures markets by utilizing methods appropriate for disproving causal relationships with observational data. The hedging pressure theory of futures markets risk premiums, the generalized version of the normal backwardation theory of Keynes, is rejected. Theories predicting that the activity levels of speculators or uninformed traders affect levels of price volatility, either positively or negatively, are also rejected. According to **Beck S.E (1994)** the hypothesis that futures prices are unbiased predictors of spot prices is a joint hypothesis that markets are efficient and risk premia are absent. Rejection of unbiasedness could be caused by the failure of either premise. Here co-integration techniques are used to test market efficiency while permitting the presence of risk premia. Five commodity markets were tested at the eight and twenty-four week horizon. Results showed that all five were sometimes inefficient but no market was inefficient always. Moreover, rejections of the unbiasedness hypothesis were nearly always caused by market inefficiency rather than the presence of risk premia. In the opinion of **Booth and Ciner (2001)** found that the prices of commodity futures traded on the Tokyo Grain Exchange (TGE) do not move together in the long run. This study analyses whether their empirical results remain true for a more recent period. The empirical results suggest that the co-integrating relation exists among commodity futures contracts from 2000 to 2003, but not earlier during the 1990s. This indicates that the price mechanism works better and the long-run relationships among prices become more apparent as a market develops**.**

According to **William j.crowder et al. (1993)** market efficiency definition which says that "price changes from one period to next period should be unpredictable given current information". According to the definition the researcher says that market efficiency futures prices should be unbiased predictor of the futures spot price, the basis for the rejection of the market efficiency is been due to existence of risk premium which did account for more than zero return in the futures market, that is the

same reason researcher believe that the investors should be given the return for the amount of risk undertaken by them.

According to **T.Randall et al. (1993)** investigation being carried by them they found that the considerable efforts has been devoted to measure the dynamics of price discovery when both the cash and futures market exists. The researcher stressed on the importance of managing market price risk specially for the agricultural commodities and in identifying the relationship between the local and the national traded commodity futures market and it is been prolong debate on the Futures market represents an assimilation of all relevant information regarding demand and supply relationship for the given commodity in some future time period and stressed more on storable commodities because to understand in better way the causal relationship between futures and cash markets which leads to a more comprehensive understanding between basis relationship and price forecasting opportunities in the market.

According to **Haigh, M.S (2000)** the relationship between freight cash and futures prices is investigated using co-integration econometrics. Results illustrate that the BIFFEX futures market is unbiased, and hence efficient for the current, one, two, and quarterly contract horizons. Since the futures contract is based on an index of various shipping routes, which has undergone several changes since its inception, stability in the relationship between the spot and futures rates is investigated using rolling co-integration techniques. Results indicate that the futures contract appears to have become more efficient over time in predicting the spot rate, and that the decrease in trading volume found in the BIFFEX market is not driven by a lack of efficiency in this market. Rather, the decrease in futures trading might be attributed to the growth rate of the freight forward market. This article incorporates the long-run co-integrating relationships between cash and futures prices in a forecasting model and compares the forecasting performance of this model with several alternatives. It is found that while the futures price is the best predictor of future spot rates for the current-month contract, time-series models can outperform the futures contract at longer contract horizons.

In the opinion of **Neil Kellard (2002)** investigates the claim that the finding of co-integration between commodity spot and lagged futures rates reflects the existence of commodity arbitrage and not, as is generally accepted, long-run market efficiency.

The methodology of Kellard et al. (1999) is employed to match spot and lagged futures rates correctly for the UK wheat futures contract traded at LIFFE. Bi-variate analysis shows that spot and lagged futures rates are co-integrated with the vector (1, -1), a necessary condition for market efficiency. However, at variance with asymptotic theory, in a tri-variate VECM estimation, the spot rate, lagged futures rate and lagged domestic interest rate are shown to be co-integrated with the vector (1, −1, 1). The "co-integration" paradox is explained by investigating the relative magnitudes of the forecast error and the domestic interest rate. The small sample results demonstrate that it is impossible to distinguish between the influence of commodity arbitrage and the existence of market efficiency using co-integration-based tests. In summary, this work implies that such tests are not wholly appropriate for evaluating commodity market efficiency.

In the opinion of **Neil Kellard et.al. (1999)** the ability of futures markets to predict subsequent spot prices has been a controversial topic for a number of years. Empirical evidence to date is mixed; for any given market, some studies find evidence of efficiency, others of inefficiency. In part, these apparently conflicting findings reflect differences in the time periods analyzed and the methods chosen for testing. A limitation of existing tests is the classification of markets as either efficient or inefficient with no assessment of the degree to which efficiency is present. This article presents tests for unbiasedness and efficiency across a range of commodity and financial futures markets, using a co-integration methodology, and develops a measure of relative efficiency. In general, the findings suggest that spot and futures prices are co-integrated with a slope coefficient that is close to unity, so that the postulated long-run relationship is accepted. However, there is evidence that the long-run relationship does not hold in the short run; specifically, changes in the spot price are explained by lagged differences in spot and futures prices as well as by the basis. This suggests that market inefficiencies exist in the sense that past information can be used by agents to predict spot price movements. A measure of the relative degree of inefficiency (based on forecast error variances) is then used to compare the performance of different markets.

Qingfeng "Wilson" Liu (2005) this paper examines the relations among hog, corn, and soybean meal futures price series using the **Perron (1997)** unit root test and autoregressive multivariate co-integration models. Accounting for the significant

seasonal factors and time trends, we find the three series are co-integrated with one single co-integrating vector, whose coefficients are comparable to the ratios used by the United States Department of Agriculture (USDA). Ex-post trading simulations that utilize the co-integration results generate significant profits, suggesting that market expectations may not fully incorporate the mean-reverting tendencies as indicated by the co-integration relations, and that inefficiency exists in these three commodity futures markets. Results from our ex-ante trading simulations that employ the USDA ratios also provide some evidence in this regard.

Andrew M. et al. (2000) examines short-run and long-run unbiasedness within the U.S. rice futures market. Standard OLS, co-integration, and error-correction models are used to determine unbiasedness. In addition, the forecasting performance of the rice futures market is analyzed and compared to out-of-sample forecasts derived from an additive ARIMA model and the error-correction model. The results of our unbiasedness tests and the forecasting performance of the rice futures market provide supporting evidence that the U.S. long-grain rough rice futures market is efficient. The results have important price risk management and price discovery implications for Arkansas and U.S. rice industry participants. **Wang, HH et al. (2005) t**he efficiency of the Chinese wheat and soybean futures markets is studied. Formal statistical tests were conducted based on Johansen's co-integration approach for three different cash markets and six different futures forecasting horizons ranging from 1 week to 4 months. The results suggest a long-term equilibrium relationship between the futures price and cash price for soybeans and weak short-term efficiency in the soybean futures market. The futures market for wheat is inefficient, which may be caused by over-speculation and government intervention.

Jian Yang et al. (2001) examines the price discovery performance of futures markets for storable and non-storable commodities in the long run, allowing for the compounding factor of stochastic interest rates. The evidence shows that asset storability does not affect the existence of co-integration between cash and futures prices and the usefulness of future markets in predicting future cash prices. However, it may affect the magnitude of bias of futures markets' estimates (or predictions) for future cash prices. These findings have several important implications for commodity production decision making, commodity hedging, and commodity price forecasting.

Research on industrial commodities such as oil, copper and precious metals, among others, is much richer on explaining their co-movements and information In a laboratory application on the historical correlations between the gold price and a group of dollar exchange rates and indices including dollar/euro, dollar/pound, dollar/yen, exchange rate index-broad and exchange rate index-major, the students found that the dollar/euro exchange rate has the highest correlation with the gold price over the daily period 1999-2009. 5 transmissions than on illustrating their volatility and correlation dependency and interdependence. Moreover, research on volatility is more extensive for oil and energy than for precious metals. Within the precious metals, the research on volatility primarily employs univariate models of the GARCH family, addresses volatility dependency but not interdependency and focuses on one or two precious metals, neglecting other major ones such as platinum and palladium.

McKenzie et al. **(2001)** explored the applicability of the univariate power ARCH volatility model (PARCH) to precious metals' futures contracts traded at the London's Metal Exchange (LME).Found that the asymmetric effects are not present and the model did not provide an adequate explanation of the data. **Tully and Lucey (2007)** used the univariate (asymmetric) power GARCH model (APGARCH) to examine the asymmetric volatility of gold. They concluded that the exchange rate is the main macroeconomic variable that influences the volatility of gold but few other macroeconomic variables had an impact. **Batten and Lucey (2007)** studied the volatility of gold futures contracts traded on the Chicago Board of Trade (CBOT) using intraday (high frequency) and intraday data. They used the univariate GARCH model to examine the volatility properties of the futures returns and the alternative nonparametric Garman-Klass volatility range statistic **Garman and Klass, (1980)** to provide further insights in intraday and intraday volatility dynamics of gold. The results of both measures provided significant variations within and between consecutive time intervals. They also found slight correlations between volatility and volume. In terms of nonlinearity and chaotic structure, **Yang and Brorsen (1993)** concluded that palladium, platinum, copper and gold futures have chaotic structures. In contrast, **Adrangi and Chatrath (2002)** found that the nonlinearity in palladium and platinum is inconsistent with chaotic behavior. They concluded that ARCH-type 6 models with controls for seasonality and contractibility explained the nonlinear dependence in their data for palladium and platinum. They did not examine chaotic

behavior of other precious metals. In comparison with other commodities, **Plourde and Watkins (1998)** compared the volatility in the prices of nine non-oil commodities (including gold and silver) to volatility in oil prices. Utilizing several non-parametric and parametric tests, they found that the oil price tends to be more volatile than the prices of gold, silver, tin and wheat. They argued that the differences stand out more in the case of precious metals. **Hammoudeh and Yuan (2008)** included three univariate models of the GARCH family to investigate the volatility properties of two precious metals (gold and silver) and one base metal (copper). They found that, in the standard univariate GARCH model, gold and silver have almost the same volatility persistence, which is higher than that of the pro-cyclical copper. In the EGARCH model, they found that only copper has asymmetric leverage effect, and in the CGARCH model the transitory component of volatility converges to equilibrium faster for copper than for gold and silver. Using a rolling ARMA (1, 1)-GARCH (1,1).

Watkins and Mc Aleer (2008) showed that the conditional volatility for two nonferrous metals, namely aluminum and copper, is time-varying over a long horizon. In this paper, we include ARMA in the conditional mean equation to account for possible nonlinearity. Recent research has shown that ignoring this attribute may kill some of the dynamics of the relationships of the model the recent literature has used different ways to deal with non-linearity. Pertinent articles on this subject can be found in the book edited by Schaeffer (2008). Other articles include (**Westerhoff et al.2005; Kyrtsou and Labys 2007; Jae. H et al. 1999**) the researcher investigated futures and spot relationship from Korean Market the sample data is from May 3,1996 to October 16,2000 i.e. for nearly for four years the authors used the intraday data and applied various models such as SEM,VAR in the current study and investigated the Lead- Lag relationship and the equation models resulted into following Indication that from the inception of Korean Futures markets futures lead the spot by at least 30 minutes and concluded that there is a strong relationship among the futures markets and the spot market.

Since the introduction of futures markets it is seen that the market commonly behaves in a very volatile fashion , and this finding will help in further research better understand to examine in a better manner for the developing countries like India other Asian countries for newly develop statistical and financial strategies or models. Several studies such as **Fama (1965) and Oldfield and Rogalski (1980)** the

researcher proof that return on equity is at peek volatile during trading hours other than non-trading hours. **French and Roll (1986)** observed that dealing hour return inconsistency is much greater than non-dealing hour variance and attributed the extra variance for the most part to private information during the dealing hours. **Lauterback and Monroe (1989)** in a study acknowledged the proofs that effect of information is always there on futures market and simultaneously the effect of noise dealing is found on Intraday gold futures which can be seen in various international Exchanges such as the Chicago Mercantile Exchange (CME) one of the oldest derivatives exchange in the Globe. **Goodhart and O'Hara (1997)** and a current textbook by **Dacarogna et al. (2001)** the researchers concentrated on the issues and its related complications that ascend in finance with high frequency. According to **Prabhat M et al.(2013)**National Stock Exchange (NSE) and Bombay Stock Exchange (BSE) of India as a sample to study the extra dealing hours volatility in equity market and document the proof that the extra trading hours trading hour volatility is present in equity Gold futures market during the course of a trading day. Further, the researcher found that the relation of extra dealing hour volatility with the information with formal and informal communication and suggested that to lessen the variances throughout the open of trading time by dropping non-dealing hours of the day.

According to **Schap and Dan, (2003)** futures commodity exchanges play an essential role provides an integrated marketplace where market operator scan determine the prices of commodities for futures distribution and where risk-averse individuals be able to swing commodity price risk to others, who are zealous to bear it. According to **Sahadevan, (2002); Robinson, (2003)** derivatives, futures, options and swaps provide several financial paybacks, mainly the providing to improve the foreseeable risk of price volatility. According to **Varangis et al. (2003)** the usage of market-based price devices to alleviate price risk provides farmers with new substitutes for availing credit and insurance amenities and allows them greater inevitability in planning on farm their happenings. In the opinion of (**Kellard et al.1999; Haigh.2000)**a market is said to be efficient when the futures price is unbiased predictor of spot prices at the termination of contract maturing at time "T" and it should be equal to Spot price this process of unbiasedness is called as Market efficiency and the current futures price contract in an efficient commodity market which indicates that futures prices are

balanced predictors of spot prices with no arbitrage opportunity and ensures that a risk premium is not present **Haigh, (2000)**. The market efficiency evaluation under co-integration analysis recognizes that time series for spot and futures prices are usually non-stationary variables **Shen and Wang, (1990)**; **Fortenbery and Zapata, (1993); Wang and Ke (2005**) and if these series are found to be non-stationary, then it is necessary to test for co-integration as a precondition for market efficiency and unbiasedness **Kellard et al., (1999)** the researcher finds that there is no co-integration between spot and futures prices is normally interpreted to imply either market inefficiency or that the(spot and futures) markets do not represent the same underlying asset. The absence of co-integration means the violation of the necessary condition for the simple efficiency hypothesis, which implies that the futures price is not an unbiased predictor of the spot price on maturity **(Chowdhury, 1991; Krehbiel and Adkins, 1993; Crowder and Hamed, 1993; Silvapulle and Moosa, 1999)** this follows from the absence of a long-run relationship between spot and futures prices. Questions concerning "what constitutes commodity price volatility and how it should be measured" have generated considerable debate. Beginning with **Massell (1970),** most empirical studies attempt to measure unanticipated price movements. **Bhattacharya (2007); Sahi and Raizada (2006)** found that commodity futures market is not efficient in the short-run and social loss statistics also indicate poor price discovery in the commodity market. Future prices do not lead to spot prices in the Indian context refuting the objective of price discovery of commodity futures markets. There have been a number of studies that have analyzed efficiency of commodity markets in the developed countries. The efficiency of commodity markets can be analyzed by using approaches of **Fama (1970); Elam and Dixon (1988)** have shown the invalidity of conventional F tests for market efficiency estimation for non-stationary time series modeling. **Stein (1991)** has estimated the social loss due to inefficiency of the future markets. Similar study has been conducted for future market in China.

2.3.1 Summary of the literature Reviewed

From the literature related to market efficiency in futures market and price discovery it can be summarized that the Price discovery results are encouraging given the blossoming atmosphere of commodity market place in India. Though the market does not seem to be viable. Market has witnessed phenomenal growth in terms of goods on

agreement, trade capacity, involvement, are most important realistic distribution. Different researcher aimed to investigate the short-run as well as long-run market efficiency of Indian commodity futures markets using different asset pricing models. As far as long-run efficiency is concerned, it is found that near month futures prices of most of the commodities are co-integrated with the spot prices. The co-integration relationship is not found for the next to near months futures contracts, where futures trading volume is low few authors find support for the hypothesis that thinly traded contracts fail to forecast future spot prices and are inefficient. The unbiasedness hypothesis is rejected for most of the commodities. It is also found that for all commodities, some inefficiency exists in the short run.

2.4 Concluding Remarks

After studying the Literature on the bases of on Samuelson's hypothesis in favor or against, literature related to Returns and Investments, market Efficiency, price dynamics and price discovery we can conclude that there is an ample scope of further research in the Indian context. When there is a long time to the maturity date little is known about the Futures prices and the Spot prices to converge towards the expiration of contract, as a result futures prices will not respond significantly to new information about the underlying commodities. Different commodities are studied by different researchers in worldwide exchange and worldwide commodities but still the results of Samuelson's hypothesis are mixed. And similar is the case with inventory, volume/open interest, growing conditions and seasonality in testing the maturity effect. Some researchers are against the Samuelson's hypothesis using, inventory, volume/open interest, growing conditions and seasonality in testing the maturity effect and further concluded that the volatility series is more dependent on trading volume compared to the open interest or time to maturity.

2.5 Research Gaps

1) It has seen from the previous literature that very few studies have been conducted on the MCX commodity futures contracts so, there is high scope of numerous research for the researcher in various Agricultural, Bullion, Metal etc.in Indian Commodity Futures Market.
2) Futures market ability is one of the most extensively studied subjects in the realistic works. From the government policy point of view, an efficient market means market interventions such as imposing price stabilization policies,

although some of the conclusions reached in the literature reflect unaffected competence or incompetence, some of them may replicate the dearth of consideration paid to the institutional aspects governing the functioning of futures markets.

3) The furthermost substantial side for commodities though not so far broadly studied. The study of the effect of seasonality on the efficiency select commodities futures market becomes even more essential in denominated country like India. In a country like India, where there have been allegations of inflation on commodity futures trading, an empirical investigation is utmost important and hence required. For instance, Govt. of India decided to suspend the futures trading in urad, tur and wheat in early 2007 due to the same reason.
4) It is also found that there are very few studies that have explored the efficiency of the commodity futures markets in Indian context in a detailed manner, especially at individual commodity level. This study analyzes the efficiency of commodity markets in India by assessing relationship between futures prices and spot market prices selected commodities to fill up the research gap.

Based on the research gaps identified after thorough literature review, the next chapter deals with the research methodology adopted to satisfy the objectives of the study.

Chapter: 3 Research Methodology

Chapter: 3

Research Methodology

This chapter is based on the research gaps and the literature review which have been identified in the previous chapter. Now this chapter deals with the methodology adopted to conduct research. The current chapter is proceeding in the following fashion. The first part discusses the need for the study. section 3.1.1,3.1.2,3.1.3and 3.1.4 discusses the objectives of the study, Hypothesis Formulation, data description, and statistical tools respectively used in the present study section 3.3 and 3.4 discuss the Samuelson's Hypothesis, ADF test with intercept and trend, ARCH(1,1)-GARCH(1,1), Unit root, Johensen's co-integration, Granger causality which has been used in explaining the results. Section 3.5, 3.6, 3.7and 3.8 shows the calculation of variables which have been used in the study.

3.1 Need of the study

Firstly to study Samuelson (1965) hypothesis that futures price volatility increases as the futures contract approaches its expiration. The relation amid the volatility and time to maturity has significant inference for hedging strategies. Interestingly, so far the empirical evidence in favor of the Samuelson Hypothesis (maturity effect) is mixed in various markets. Considering no significant work to examine the relationship is so far carried out in commodity derivative markets of India, so, the thesis is concentrating in testing the Samuelson Hypothesis on 10 commodities traded on Multi-Commodity Exchange (MCX), India. This hypothesis can be examined by applying different regression techniques to test the hypothesis for 10 commodities (Aluminium, Nickel, Copper, Gold, Silver, Natural Gas, Crude Oil, Zinc, Lead and Potato) using inter-day data on MCX India.

Secondly to study the ongoing global and domestic reforms in agriculture and allied sectors, the Indian Government is reducing its direct market intervention and encouraging private participation based on market forces. This has led to increased exposure of agricultural and non-agricultural produce to price risk and other market risks, which consequently emphasize the importance of futures markets for price discovery and price risk management. The purpose of this thesis is to analyze the efficiency of agricultural commodity markets by assessing the relationships between futures prices and spot market prices of 10 agricultural and non-agricultural

commodities such as (Aluminium, Nickel, Copper, Gold, Silver, Natural Gas, Crude Oil, Zinc, Lead and Potato) using inter-day data on MCX India.

3.1.1 Objectives of the study

The primary objectives of any future exchange are authentic price discovery and an efficient price risk management. The beneficiary includes those who trade in the commodities being offered in the exchange as well as those who have nothing to do with future trading. It is because of price discovery and risk management through the existence of future exchange that a lot of businesses and services are able to function smoothly. The present study "Commodities Derivatives and Risk Management-A study on Futures Commodities" is aimed to cover the following:

1. To study the Samuelson Hypothesis that the futures price volatility increases as the futures contract approaches its expiration along with open interest and volume traded in 10 commodity futures contracts traded on MCX India.
2. To study the relationship between futures price volatility and time to expiry as well as open interest and trading volume in ten commodity futures contracts traded on Multi-Commodity Exchange (MCX), India.
3. To test the Market efficiency of Futures and Spot markets.
4. To examine the causal relation between the Spot and futures prices.
5. To test the Co-integration between the Future and the spot prices

3.1.2 Hypotheses of the Study

From the above objectives of the study, the following hypotheses are framed and tested in the present study.

H_{O1}: There is no significant Effect of Nickel Trading Volume on Volatility

H_{O2}: There is no significant Effect of Copper Trading Volume on Volatility

H_{O3}: There is no significant Effect of Crude Oil Trading Volume on Volatility

H_{O4}: There is no significant Effect of Silver Trading Volume on Volatility

H_{O5}: There is no significant Effect of Aluminium Trading Volume on Volatility

H_{O6}: There is no significant Effect of Natural Gas Trading Volume on Volatility

H_{07}: There is no significant Effect of Zinc Trading Volume on Volatility

H_{08}: There is no significant Effect of Gold Trading Volume on Volatility

H_{09}: There is no significant Effect of Lead Trading Volume on Volatility

H_{10}: There is no significant Effect of Potato Trading Volume on Volatility

H_{11}: There is no significant Effect of Nickel Open Interest on Volatility

H_{12}: There is no significant Effect of Copper Open Interest on Volatility

H_{13}: There is no significant Effect of Crude Oil Open Interest on Volatility

H_{14}: There is no significant Effect of Silver Open Interest on Volatility

H_{15}: There is no significant Effect of Aluminium Open Interest on Volatility

H_{16}: There is no significant Effect of Natural Gas Open Interest on Volatility

H_{17}: There is no significant Effect of Zinc Open Interest on Volatility

H_{18}: There is no significant Effect of Gold Open Interest on Volatility

H_{19}: There is no significant Effect of Lead on open Interest on Volatility

H_{20}: There is no significant Effect of Potato open Interest on Volatility

H_{21}: There is no significant Effect of Nickel time to maturity on Volatility.

H_{22}: There is no significant Effect of Copper time to maturity on Volatility

H_{23}: There is no significant Effect of Crude Oil time to maturity on Volatility

H_{24}: There is no significant Effect of Silver time to maturity on Volatility

H_{25}: There is no significant Effect of Aluminium time to maturity on Volatility

H_{26}: There is no significant Effect of Natural Gas time to maturity on Volatility

H_{27}: There is no significant Effect of Zinc time to maturity on Volatility

H_{28}: There is no significant Effect of Gold time to maturity on Volatility

H_{29}: There is no significant Effect of Lead time to maturity on Volatility

H_{30}: There is no significant Effect of Potato time to maturity on Volatility

H_{31}: The Spot price of Nickel is not Co-Integrated with Future price of Nickel

H_{32}: The Spot price of Copper is not Co-Integrated with Future price of Copper

H_{33}: The Spot price of Crude Oil is not Co-Integrated with Future price of Crude Oil

H_{34}: The Spot price of Silver is not Co-Integrated with Future price of Silver

H_{35}: The Spot price of Aluminium is not Co-Integrated with Future price of Aluminium.

H_{36}: The Spot price of Natural Gas is not Co-Integrated with Future price of Natural Gas.

H_{37}: The Spot price of Zinc is not Co-Integrated with Future price of Zinc.

H_{38}: The Spot price of Gold is not Co-Integrated with Future price of Gold

H_{39}: The Spot price of Lead is not Co-Integrated with Future price of Lead

H_{40}: The Spot price of Potato is not Co-Integrated with Future price of Potato

H_{41}: Spot price of Nickel has a unit root

H_{42} : Future price of Nickel has a unit root

H_{43}: Spot price of Copper has a unit root.

H_{44}: Future price of Copper has a unit root

H_{45}: Spot price of Crude Oil has a unit root

H_{46}: Future price of Crude Oil has a unit root

H_{47}: Spot price of Silver has a unit root

H_{48}: Future price of Silver has a unit root

H_{49} : Spot price of Aluminium has a unit root

H_{50} : Futures price of Aluminium has a unit root

H_{51}: Spot price of Natural Gas has a unit root

H_{52}: Futures price of Natural Gas has a unit root

H_{53} : Spot price of Zinc has a unit root

H_{54}: Futures price of Zinc has a unit root

H_{55}: Spot price of Gold has a unit root

H_{56}: Future price of Gold has a unit root

H_{57} : Spot price of Lead has a unit root

H_{58} : Future price of Lead has a unit root

H_{59}: Spot price of Potato has a unit root

H_{60}: Future price of Potato has a unit root

H_{61}: Spot prices of Gold does not Granger cause Future price

H_{62}: Future prices Gold does not Granger cause Spot price

H_{63}: Spot prices of Copper does not Granger cause Future price

H_{64} : Future prices Copper does not Granger cause Spot price

H_{65} : Spot prices of Silver does not Granger cause Future price

H_{66} : Future prices Silver does not Granger cause Spot price

H_{67}: Spot prices of Zinc does not Granger cause Future price

H_{68}: Future prices Zinc does not Granger cause Spot price

H_{69}: Spot prices of Nickel does not Granger cause Future price

H_{70}: Future prices Nickel does not Granger cause Spot price

H_{71}: Spot prices of Natural Gas does not Granger cause Future price

H_{72}: Future prices Natural Gas does not Granger cause Spot price

H_{73}: Spot prices of Crude Oil does not Granger cause Future price

H_{74} : Future prices Crude Oil does not Granger cause Spot price

H_{75}: Spot prices of Aluminium does not Granger cause Future price

H_{76}: Future prices Aluminium does not Granger cause Spot price

H_{77}: Spot prices of Potato does not Granger cause Future price

H_{78}: Future prices Potato does not Granger cause Spot price

H_{79} : Spot prices of Lead does not Granger cause Future price

H_{80} Future prices Lead does not Granger cause Spot price

3.1.3 Scope of the study

Under commodity derivatives forward, future, option and swap many other, are available but focus of this research is on the future commodity prices. A number of commodities which traded at MCX such as future commodity derivatives like Agro-based Commodities, Soft Commodities, Live Stock, Energy, Precious Metals etc. here for making an analysis bullion commodity such as Gold Silver Copper Zinc Nickel Natural Gas Crude Oil Aluminium Potato And Lead commodities have been selected from the most popular Exchange i.e. MCX. The study also provides regulatory framework for commodities market in India.

1. The study will be covering the aspects such as price volatility and market conditions and prices of spot and Future. Samuelson's Hypothesis for price volatility and time to maturity
2. Derivatives are generally perceived instruments which cause big losses suggestions for the proper management for the end users have been propose in light of the analyses.
3. In this study only 10 commodities such as Gold, Silver & few other Metal, Agricultural commodities has been considered.
4. The study is conducted to predict the future prices for the investors, by analyzing the Market efficiency of the Spot and Futures prices.
5. The analysis is based near month contracts closing prices of Gold, silver and other commodities in Futures Commodity market.

3.1.4 Data Descriptive

The dataset obtained in the study consist of the futures and Spot prices for commodity futures market in Indian Futures market that is Multi Commodity Market (MCX).The time period examined is from 2011-2014.The MCX data is readily available from the beginning of 2011. Overall, the study examines ten commodities with a total of 60 contracts and with the same ten contracts with 6968 observations. The basic descriptive features about the commodity futures markets investigated in this study are summarized in Table 1.2.

Several Futures contracts with totally different maturities are sometimes sold at any given time; therefore, a criterion must be outlined in order to get continued Futures price series. This work adopts a standard methodology within the literature by rolling

over contracts. At any time, most trading activities are single contract; usually the contract that is closest to maturity. Thus, the data for the contract that is close to maturity is included. When the contract comes in the month when it matures, the cost for the next near-to-maturity contract is preferred. The maturity month is omitted as the Futures prices in the maturity month will be used as substitutes for the spot prices. **Fama and French (1988)** "*suggest using the near futures prices for the spot prices based on the theory that close to expiry futures should approach spot prices"*. Therefore, when constructing the continuous futures time series, futures prices in the contract month are excluded. Due to non-availability of hourly/minutes-by-minute data, the current study utilizes daily data for the analysis. As a first step, daily continues compound percentage return of the commodity futures is determined by taking the natural logarithmic first difference of the daily closing inter-day prices of the commodities traded on MCX.

Table 3.1: Basic Facts of Futures contracts studied based on Samuelson's hypothesis

This table outlines basic facts of the commodity futures investigation in this study. All data has been retrieved from MCX .Expiration month is a numerical representation of the month in which each contract expires 1=January; 2=February; 3=March and so on).Overall, the study examines 60 futures contracts of ten commodities in multi commodity exchange futures market.

Commodity	**Futures Exchanges**	**Sample Period**	**Number of contracts**	**Expiration Month**
Nickel	MCX	2013-2014	06	8,9,10
Copper	MCX	2013-2014	06	8,9,10
Crude oil	MCX	2013-2014	06	8,9,10
Silver	MCX	2013-2014	06	2,4,12
Aluminium	MCX	2013-2014	06	8,9,10
Natural Gas	MCX	2013-2014	06	6, 7, 8
Zinc	MCX	2013-2014	06	8,9,10
Gold	MCX	2013-2014	06	2, 4, 6
Lead	MCX	2013-2014	06	6, 7, 8
Potato	MCX	2013-2014	06	5, 7, 9
Total			60	

Table 3.2: Basic Facts of Futures contracts studied based on co-integration hypothesis

This table outlines basic facts of the commodity futures investigation in this study .All data has been retrieved from MCX. Number of observation or days under study. The period of study from 2011 to 2014.Overall, the study examines 10 futures commodities in multi commodity exchange futures market.

	Commodity	Futures Exchanges	Sample Period	Number of observation(days)
	Nickel	MCX	2011-2014	1076
	Copper	MCX	2011-2014	412
	Crude oil	MCX	2011-2014	733
	Silver	MCX	2011-2014	80
	Aluminium	MCX	2011-2014	1110
	Natural Gas	MCX	2011-2014	1000
	Zinc	MCX	2011-2014	996
	Gold	MCX	2011-2014	89
	Lead	MCX	2011-2014	1114
	Potato	MCX	2011-2014	358
Total	10			6968

3.1.5. Statistical tools used for the study

The proposed work is based on empirical study and the research is descriptive and explanatory in nature. The statistical tools such as Volatility, ADF, PP, Johansen's Co-Integration test Statistics, Granger causality, ARCH, and GARCH etc. are used. As it is known that volatility is associated with risk and return. Volatility refers to variability of observations around its mean value. Researchers in the field of finance, especially in capital market, have realized the importance of volatility models. In this study the researcher is concerned with constant volatility model such as Generalized Autoregressive Conditional Heteroscedasticity (GARCH) model. It is one of the most popular models. Before applying GARCH model we have checked for stationarity by applying ADF.

EVIEWS package has been used for data analysis.

3.2 Test of Samuelson's Hypotheses

The test of the Samuelson Hypothesis is based on commodity futures contracts traded on MCX India. The present study tests the volatility dynamics of commodity futures market and the potential sources of volatility such as Trading volume(VOL) Open Interest (OI) and Time to Maturity (T).Trading volume refers to the amount of future contracts traded in a given period of time during a trading day .Open Interest is described as the total number of contracts that are not closed or yet to be squared off as on a particular day .Time to Maturity is the number of calendar days until the futures contract expires. In our present analysis, time to maturity on the last trading days is taken to be Zero.

For examining the impact of these parameters on the volatility, following futures contracts were taken for the analysis: 5 metal futures (Aluminum Nickel, Copper, Lead, and Zinc) 2 Bullion futures (Gold, Silver), 2 Energy futures (Natural Gas and Crude Oil) 1 Agricultural future (Potato).

Data have been collected for all the Commodities from MCX India .The study utilize daily data for the analysis. The first step is the calculation of daily continues compounded percentage return of the commodity futures.

$$R_t = \ln (P_t/P_{t-1})*100$$

The summarized data can be seen in table 2 of the futures contract. Samuelson Hypothesis has been tested for two unlike years during the same period.

3.2.1 Examining the effect of Trading Volume, Open Interest and Time to Maturity on Volatility

A substantial volume of financial research suggests that time-series model the conditional variance of error term, are more appropriate for handing the financial data over the linear time series models, which have the ability for accommodating the time varying heteroscedasticity and persistent behavior of volatility of return, explained in detail in Brooks(2008) here the financial time-series characteristics by employing GARCH model on the Basis Akaike Information Criteria (AIC),and Schwartz Criteria (SC) statistics, ARMA (1,1) GARCH (1,1) Model is chosen and included the Time to maturity as an exogenous explanatory variable in the conditional variance equation as given in equation (3).

$$\boldsymbol{R_t = \emptyset_0 + \emptyset_1 R_{t-1} + \theta_1 \varepsilon_{t-1} + \varepsilon_t} \quad \textbf{(2)}$$

$$\boldsymbol{\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 \sigma_{t-1}^2 + \delta_1 T_t} \quad \textbf{(3)}$$

Alpha (α_1) is usually taken as news (shocks) coefficient so as to measure the impact of recent news on the volatility. Beta (β_1) is the persistent coefficient used to measure the impact of past volatility on the current volatility. The sum of Arch and GARCH coefficient ($\boldsymbol{\alpha_1}$and$\boldsymbol{\beta_1}$) indicate the degree of persistency in volatility to test the Samuelson hypothesis to be true, the coefficient of volatility on time to maturity should be negative ($\delta_1 \leq 0$) and statistically significant , so that price volatility increases as the number of days reaches its maturity of the contract.

Futures trading activity measured by trading volume and open interest also have significant influence on the volatility of commodity futures prices. To examine the effect of future trading volume (VOL) and open interest (OI) on the volatility of futures prices, the model is, therefore further improved by including the trading volume and open interest along with the time to maturity as regressors in the conditional variance equation .By observing the influence of trading volume and open interest, we can contract an enhanced corollary regarding the effect of time to maturity on volatility.

$$R_t = \emptyset_0 + \emptyset_1 + R_{t-1} + \theta_1 \varepsilon_{t-1} + \varepsilon_t \qquad (4)$$

$$\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 \sigma_{t-1}^2 + \delta_1 VOL_t + \delta_2 OI_t + \delta_3 TTM_t (5)$$

A positive and significant value of δ_1 and δ_2 suggest a positive relationship between the volume and open interest with the volatility. A significant and negative value of δ_3 in the conditional variance equation suggests that as time-to-maturity increases, the volatility of futures prices decreases.

3.3 GARCH Model

Presented by Engle (1982), the ARCH model let the conditional variance to vary over time. The Generalized ARCH or GARCH model was proposed by Bollerslev (1986).Hypothetically the model is alike to infinitive order ARCH model. That is how it derived its name as Generalized Autoregressive Conditional Heteroscedasticity Model. The GARCH (r,m) model has a conditional volatility generally denoted as h_t. That conditional volatility is the function past conditional volatility may be denoted as $\mathbf{h_{t-r}}$ and past squared innovations in mean equation may be symbolize as $\mathcal{E}_{t-m}^2$.ARMA models are used to model the conditional variance of a process given the past is constant. For example, if the daily returns are unusually volatile, expectations may be that the tomorrow's return will also be more variable than usual. An ARMA model does not capture this type of behaviour because its conditional variance is constant. Therefore, there is a need for an improved time series model for modelling the non-constant volatility. GARCH represents such a model that has randomly varying volatility. The GARCH model is a declining weighted average of past squared residuals. The declining weights never become equal to zero. Before applying the GARCH model, we have checked for stationarity of data. Augmented Dicky-Fuller and Phillip-Perron tests are applied to check the stationarity of the data.

3.4 Augmented Dickey-Fuller (ADF) test and Phillips-Perron (PP) approach

It is with the help of Augmented Dicky-Fuller (ADF) unit root test, we come to know that we have to make the time series data stationary. The null hypothesis of the ADF test is that the data is non-stationary and needs to be differenced. Whereas, the alternative hypothesis says that the data trend stationary and can be analyzed without differencing the data. There are different cases for the ADF test equation. The first case is when the time series does not have a trend. It means that the time series is flat and rotating nearby zero. The equation in this situation has neither intercept nor a time

trend. In another case, the time series is flat but rotating around a non-zero value. Further, it has an intercept but no time trend. Yet another case is when a time series has either an up or down trend and is slowly turning round a trend line drawn from the data. This equation has an intercept and a time trend, the number of augmented lags is determined by minimizing the Schwartz Bayesian information criteria or minimizing the Akaike information criteria or lags are dropped until the last lag is statistically significant.

Phillips and Perron (1988) introduced various unit root tests for the analysis of financial time series. The Phillips-Perron unit root tests are different from the ADF tests. The main difference is in the way they deal with serial correlation and heteroscedasticity in the errors. Also, the ADF tests use a parametric auto regression to approximate the ARMA structure of the errors in the test regression, but the Phillips-Perron tests ignore any serial correlation in the test regression. The Phillips-Perron tests correct any serial correlation and heteroscedasticity in the errors of the test regression by directly modifying the t-statistics. The precondition of co-integration and causality analysis. If two or more variables are integrated of the order d where d > 0, and there exists a stationary linear combinations of these variables, the variables are said to be co-integrated. In simple words, when the linear combination of two or more non-stationary variable is a stationary process, a linear relationship between these non-stationary variables is likely to exist. That may also be regarded in the other terminology of economics as long-run equilibrium relationship that keep the two variables in equilibrium by error-correction process. The error-correction process is a process that restores the equilibrium distance between the variables. A unit root is performed by applying an autoregressive model in order to check the time series variable is non-stationary or stationary. A series is called as stationary if the mean and auto covariance of the series do not depend on time. In the present study unit root test is tested based on two approaches, one is parametric and non-parametric approaches, Augmented Dickey-Fuller (ADF) test and another one is Phillips-Perron (PP) approach to evaluate the stationarity of Spot and Futures prices. The following regression equation is behind the unit root test:

$$\Delta X_t = b_0 X_{t-1} + \sum_{i=1}^{T} b_i \Delta X_{t-1} + \varepsilon_t \qquad (1)$$

Where X_t represents the level or the first difference

b_o Represents the Null hypothesis of non-stationary

i (1) Represents stationary at the first level of difference.

The ADF tests have been performed using a constant intercept and lag length through Schwarz information criterion.

3.5 Johnson's co-integration test

The purpose of the Co-integration test is to test a group of non-stationary series are co-integrated or not, explores the long-run equilibrium relationship among variables. Johansen's Co-integration tests have been used under the present study to assess the long-run predictability among Spot and Futures prices, using maximum likelihood technique. The Johansen's Co-integration test, assuming an n-dimensional vector X_t with integration of difference i (1), estimates a vector incorporating an error correction depicted as follows:

$$\boldsymbol{X_t} = \mathrm{C} + \sum_{i=1}^{k} \prod_l \boldsymbol{X_{t-1}} + \boldsymbol{\varepsilon_t} \qquad \textbf{(2)}$$

$$\Delta \boldsymbol{X_t} = \boldsymbol{\mu} + \sum_{i=1}^{k} \boldsymbol{\Gamma \Delta X_{l-i}} + \prod_i \boldsymbol{X_{t-k}} + \boldsymbol{\varepsilon_t} \qquad \textbf{(3)}$$

Where $X_t$is an n×1 vector of the I(1) variable representing Spot and Futures price respectively, μ Is a deterministic component which may include a linear trend term, an intercept term, or bothΔ represents the first difference, $\prod t$ Is an n×r matrix of parameters indicating α and β, C is a vector of constants, k is the lag length based on the Hannan –Quinn criterion,ε_t is a random error term which indicates how many combination of X_t are stationary.

The present study assumed that the co-integrating equation (3) follows linear deterministic trends with constant intercept to have a more precise idea about the order of integration. The co-integration model asserts that if the coefficient matrix $\prod$ has reduced rank r<k, then co-integrating relationship can be determined by examining the rank of the coefficient matrix$\prod$, based on the number of co-integration vector. If X_t is a vector of I (1) variables, then $\prod X_{t-k}$ has to be stationary for ε_t to make the error term stationary. The null hypothesis of co-integration vector under is formulated based on the rank of $\prod$, indicating r=0, 1…k-1.Therefore, the co-

integration test statistics is based on co-integration vectors under the null and alternative hypotheses.

The residual vectors of the model construct two likelihood ratio test statistics, i.e. the trace test and the maximal Eigen value test. The trace statistics test the null hypotheses of r co-integration relations against the alternative of the k co-integrating relations against the alternative of the k co-integrating relations against the alternative of r+1 co-integrating relations. The Johansen likelihood λ_{trace}, and the maximal Eigen value,λ_{max} for the null hypotheses that there are at most r co-integrating vectors are given by

$$\boldsymbol{\lambda_{trace}}, = -\mathbf{T}\sum_{i=r+1}^{k}\mathbf{ln}(\mathbf{1}-\boldsymbol{\lambda_i}) \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (\mathbf{4})$$

$$\boldsymbol{\lambda_{max}} = -\mathbf{T}\,\mathbf{ln}(\mathbf{1}-\boldsymbol{\lambda_i}) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (\mathbf{5})$$

3.6 Granger Causality Test

The Granger (1969) causality test has been used to analyze the direction and causal relations between futures and the spot prices of commodities. This test predicts how much of the current value of one variable can be explained by the past values of the variable and then tries to see whether adding lagged values of prior variable can improve the explanation. Granger-caused by X if X helps in the prediction of Y, or equivalently if the coefficients on the lagged X is statistically significant. Specifically,Y_t is causing X_t if some coefficient,a_i, is zero in the following equation.

$$\boldsymbol{X_{t=C_o}} + \sum_{i=1}^{p}\boldsymbol{ai}\,\boldsymbol{\Upsilon_{t-1}} + \sum_{j=1}^{p}\boldsymbol{bjX_{t-1}} + \boldsymbol{\varepsilon_t} \ldots\ldots\ldots\ldots\ldots\ldots \quad (\mathbf{6})$$

A time series, $Y_{t,}$causes another time series,X_t if the current value of X_t can be predicted better by using past values of $Y_t$than by not doing so:

$$\boldsymbol{Y_t} = \boldsymbol{\gamma_o} + \sum_{i=1}^{p}\boldsymbol{\alpha}\,\boldsymbol{X_{t-1}} + \sum_{j=1}^{p}\boldsymbol{\beta}\,\boldsymbol{Y_{t-j}} + \boldsymbol{\mu_t} \ldots\ldots\ldots\ldots\ldots \quad (\mathbf{7})$$

Where p is the number of lag used for the variable. The regression equations (6) and (7) test the existence of short term relationship between the variables X and Y moreover, if both futures and Spot prices are co-integrates, then causality must exist in uni-directional or bi-directional or no-causality relationship. The test statistics for the causality is based on the t-statistics, which tests whether lagged information on a variable Y provides any statistically significant information about a variable X in the

presence of Lagged X. It is important to note that the statement "X Granger causality measures precedence and information content but does not by itself indicate causality in true sense presents the co-integration results from the application of the Johansen's method of reduced rank regression using the Vector error correction model. The Johansen λ_{trace}(trace statistics) and λ_{max} maximal Eigen value, analysis indicates that the Null hypothesis of the non-co-integration (r=0) is rejected at 0.05 level of significance. The rejection of reduced rank implies that the data series for these commodities are stationary, despite the earlier conclusion drawn from the unit roots. This implies that with increase in the Lag length, prices of these commodities becomes stationary. In this case the commodities could be excluded from further analysis.

3.7 Significance of the study

Predicting futures prices volatility, in view of Samuelson's hypothesis, is very useful for the participants such as traders, hedger's speculators etc. taking part in the futures markets. The relation of the futures price volatility and the maturity is essential for setting the margin requirement s in the futures markets. The margin required for trading is directly related to the futures contract price volatility. As a result, if the futures price volatility increases towards the expiry of the futures contract, as recommended by the Samuelson's hypothesis, the margin required for trading so as to cover the margin calls should increase. The relation of volatility and maturity also has a significant inference for the hedging strategies.

Depending on whether this relation between the futures prices volatility and time to maturity is in accordance with the Samuelson's Hypothesis or not hedgers should choose futures contracts with either short or long horizons to maturity. Thus hedging strategies should be adjusted as maturity advances. When the Samuelson's Hypotheses holds, hedgers may prefer switching to contracts further away from expiration day otherwise, they face higher volatility and requires a higher risk premium. Unlike hedgers, speculators would like to trade during periods of high volatility provide liquidity in the market and consequently enable speculators to earn short-term returns.

India is still under developed Commodity market unlike the physical market, future market trades in commodity are largely used as risk management (hedging) mechanism on either physical Commodity itself or the open position in commodity

stock .Commodity market like stock and foreign exchange markets are of great help for not only for those who participates but also for the economy as a whole. Commodity market in India are still in their Initial stage of development. So, there is a need to study the Commodity market in India.

3.8 Limitations of the Study

1. The major limitation in using the co-integration and causality test is much to do with the nature of time-series data and meeting the non-stationary requirements. It is also criticized that the Granger causality does not imply a cause and effect relationship in the strict sense. It is also argued that a limitation of existing tests is the rigid classification of markets as either efficient or inefficient with no scope to measure the degree to which efficiency is contemporary.
2. This analysis will be holding good for a limited period that is based on present scenario and study conducted, future movement on selected commodities price may or may not be similar.
3. To suggestion that the study is based on fundamental and technical analysis such as price movement, relationship of Gold, Copper, Aluminium, Zinc, Nickel, Crude Oil, Natural Gas, Potato, Silver and Lead i.e., only ten commodities has been studied therefore more products can be added to the study to have more wide-opened market trends and apart from the factors used such as volume open interest and time to maturity in favor for the Samuelson's hypothesis few more factors can also be added from the Investors.
4. Only few models such as ARCH, GARCH, Johensen's co-integration model, Granger causality test has been used if included more methods would have yielded greater insight about the hypothesis
5. The study has been conducted on daily data for the year from 20012-13 and 2013-14 which is not a very long period. Secondly, the results may not generalized due to sample collection.

   The data collected have been analyzed and their discussions are being presented in the next chapter.

Chapter: 4 Results and Discussion

Chapter: 4
Results and Discussion

This chapter deals with the results of the study section 4.1 deals with the descriptive statistics of the commodity futures returns, 4.2 Augmented Dickey-Filler Approach (ADF) test,4.3 Parameter estimates table 4,4.4 Parameter estimates of table 5,4.6 Descriptive statistics of Co-integration,4.7 ADF test,4.8 Co-integration test,4.9 Granger Causality tests,4.10 Causality Test. Followed by the summary of hypothesis.

4.1 Descriptive statistics of the commodity Futures return series

Initially, beginning with the Empirical analysis by analyzing the descriptive statistics of the daily return given in Table 2 .Table 2 shows a non-normal distribution for the daily return. The contract are available for the longer duration to the shortest duration in the order of time to maturity for these contracts are higher compared to other commodities. As Silver, Gold, Copper, Potato, Crude oil, Copper are available for longer duration Lead, Zinc, Aluminium contracts having the short duration. According to duration of contracts Silver stand First, copper stands as second, third potato then fourth Crude oil five Nickel Six Lead, Zinc and Aluminium stands Constant and lastly Natural Gas stands last for the position. From this analysis we can say that contracts are available for the longer duration to the shortest duration the time to maturity .the time to maturity for contracts are higher when compared to Lead, Zinc, Aluminium and Lead for Natural Gas. The mean daily compounded percentage return on the commodity futures varied from -0.92 to 0.43 percent whereas the standard deviation on the return series varied from 0.00 to 2.14 percent the Jarque-Bera test statistics varied from 0.00 to 1299.62,thereby conforming to the non-normality of the return series. This table provides descriptive statistics for the daily return for ten commodities traded at MCX where the daily returns are calculated as the Log difference of futures closing prices specifies log (F_t / F_{t-1})*100 .This table also reports on each contract with expiration date, mean, median, max value min value standard deviation, skewness, kurtosis and Jarque-Bera statistics for testing the Null hypothesis of Normal Distribution, tested for two different year during the same period.

Table 4.1: Summary of Data statistics of the commodity Futures return series for the contracts studied

	Minimum value	Maximum value
Mean	-0.92	0.43
Standard Deviation	0.00	2.14
Jarque-Bera	0.00	1299.62

Table 4.2 Descriptive statistics of the commodity futures return series for the 10 contracts : This table provides descriptive statistics for the daily return for ten commodities traded at MCX where the daily returns are calculated as the Log difference of futures closing prices specifies log (F_t / F_{t-1})*100 .This table also reports on each contract with expiration date, mean, median, max value min value standard deviation, skewness, kurtosis and Jarque-Bera statistics for testing the Null hypothesis of Normal Distribution, tested for two different year during the same period.

Contract	Expiry date	N	Mean	Median	Max	Min	S.D	Skewness	Kurtosis	Jarque-Bera
Nickel 2013	13-Aug	98	-0.10	-0.14	3.77	-3.71	1.26	0.28	3.74	3.48
	13-Sep	96	-0.02	-0.07	4.10	-4.22	1.38	0.20	4.16	6.00
	13-Oct	98	-0.06	0.00	4.05	-4.54	1.36	-0.04	4.16	5.52
Nickel 2014	14-Aug	89	-0.06	0.00	4.08	-3.92	1.54	-0.17	3.92	3.58
	14-Sep	115	0.07	0.00	5.08	-6.66	1.67	-0.09	5.94	41.68
	14-Oct	105	0.18	0.00	4.66	-5.47	1.53	0.15	5.93	38.04
Copper 2013	13-Feb	185	1.03	100.04	100.90	99.26	0.17	-0.06	8.36	221.84
	13-Apr	191	1.06	100.04	100.63	99.26	0.16	-0.22	7.07	133.65
	13-Jun	140	1.05	100.04	100.63	99.59	0.15	0.51	5.23	35.12
Copper 2014	14-Feb	186	1.00	1.00	1.01	0.99	0.00	-0.03	8.45	230.28
	14-Apr	181	1.06	1.00	100.63	99.26	0.16	-0.02	7.02	121.81
	14-Jun	146	1.05	100.04	100.63	99.59	0.14	0.53	5.46	43.58
Crude oil 2013	13-Jun	145	-0.07	-0.01	2.90	-2.90	0.98	0.03	4.06	6.83
	13-Jul	144	-0.13	-0.01	2.92	-3.59	1.14	-0.31	3.72	5.41
	13-Aug	145	-0.15	-0.08	3.44	-3.65	1.22	-0.12	3.42	1.37
Crude oil 2014	14-Jun	129	-0.02	0.00	2.58	-2.18	0.90	-0.05	3.46	1.18
	14-Jul	133	-0.05	0.00	3.06	-3.61	0.93	-0.48	5.27	33.69
	14-Aug	129	0.05	0.00	3.20	-2.11	0.82	0.03	4.53	12.61
Silver 2013	13-May	190	0.21	0.02	9.71	1.35	1.88	16.37	1527.81	0.00
	13-Jul	169	0.28	0.15	9.73	-4.89	1.51	1.65	13.34	829.50
	13-Sep	147	0.37	0.04	10.06	-8.86	2.14	0.06	9.23	237.85
Silver 2014	14-May	227	0.01	0.00	4.08	-8.62	1.66	-1.36	9.34	449.44
	14-Jul	224	0.12	0.00	4.08	-4.41	1.20	0.40	6.65	130.29
	14-Sep	193	0.08	0.00	4.08	-4.20	1.02	-0.15	6.65	107.65
Aluminium 2013	13-Aug	96	-0.16	-0.12	3.04	-4.71	1.22	-0.59	5.44	29.52
	13-Sep	97	-0.03	0.00	5.40	-4.78	1.30	-0.12	-7.23	72.55
	13-Oct	97	-0.16	-0.12	3.04	-4.71	1.22	-0.59	5.44	29.52

Table 4.2 continued										
Contract	**Expiry date**	**N**	**Mean**	**Median**	**Max**	**Min**	**S.D**	**Skewness**	**Kurtosis**	**Jarque-Bera**
Aluminium 2014	14-Aug	89	-0.11	0.00	4.08	-3.39	1.10	0.81	7.04	70.38
	14-Sep	105	-0.06	0.00	4.08	-8.40	1.29	-2.02	19.76	1299.62
	14-Oct	99	-0.13	0.00	1.91	-3.92	0.99	0.96	6.12	55.23
Natural gas 2013	13-Aug	65	0.03	0.18	5.54	-5.68	1.97	-0.18	3.97	2.88
	13-Sep	75	0.05	0.09	4.26	-5.43	1.93	-0.29	3.38	1.50
	13-Oct	74	0.00	0.00	4.06	-4.36	1.86	-0.13	3.13	0.27
Natural gas 2014	14-Aug	64	0.20	0.22	4.28	-4.02	1.68	0.03	3.14	0.06
	14-Sep	64	0.18	0.08	4.48	-3.80	1.77	0.29	3.00	0.89
	14-Oct	72	0.06	-0.20	4.23	-3.61	1.81	0.34	2.62	1.78
Zinc 2013	13-Aug	89	-0.24	-0.09	2.60	-4.63	0.94	-0.82	7.65	89.99
	13-Sep	96	-0.06	0.00	5.36	-5.25	1.35	-0.15	7.40	78.76
	13-Oct	96	-0.05	0.00	5.12	-6.10	1.38	-0.35	7.73	91.58
Zinc 2014	14-Aug	89	-0.14	0.00	4.07	-3.38	1.13	0.11	5.48	23.06
	14-Sep	105	-0.11	0.00	4.05	-3.91	1.12	-0.03	5.95	38.05
	14-Oct	105	-0.14	0.00	4.48	-3.91	1.10	0.12	7.22	78.10
Gold 2013	13-Feb	183	-0.92	-0.11	4.80	-4.01	0.54	6.86	122.40	0.00
	13-Apr	178	-0.05	-0.09	3.83	-4.17	1.07	0.31	6.05	71.93
	13-Dec	182	0.00	0.00	0.05	-0.05	0.01	0.06	8.15	201.61
Gold 2014	14-Feb	154	0.03	0.00	2.98	-2.95	0.86	-0.08	5.84	52.03
	14-Apr	214	-0.03	0.00	4.26	-5.41	1.06	-0.39	7.36	175.21
	14-Dec	155	0.00	0.00	0.03	-0.03	0.01	-0.18	5.86	52.99
Lead 2013	13-Aug	99	-0.26	-0.24	3.55	-5.36	1.32	-0.28	5.29	22.92
	13-Sep	97	-0.05	0.00	4.55	-5.63	1.41	-0.40	6.01	39.05
	13-Oct	98	-0.08	0.00	4.26	-5.90	1.40	-0.27	6.00	38.06
Lead 2014	14-Aug	79	-0.06	0.00	4.05	-1.94	1.00	1.15	6.19	51.04
	14-Sep	105	0.01	0.00	4.05	-3.89	1.08	0.59	6.89	72.22
	14-Oct	105	0.04	0.00	4.04	-3.85	1.02	0.11	7.21	77.92
potato 2013	13-Jun	173	0.01	0.20	4.08	-3.92	1.67	-0.15	2.92	0.31
	13-Jul	70	0.43	0.18	6.94	-8.34	1.90	-0.80	9.47	129.41
	13-Aug	72	0.16	0.27	4.07	-3.91	1.88	-0.28	2.90	0.98

Table 4. 2 Continued										
Contract	**Expiry date**	**N**	**Mean**	**Median**	**Max**	**Min**	**S.D**	**Skewness**	**Kurtosis**	**Jarque-Bera**
potato 2014	14-Jun	159	-0.20	0.00	4.35	-4.17	1.72	0.23	3.44	2.74
	14-Jul	158	-0.20	0.00	6.18	-3.91	1.73	0.31	3.91	7.89
	14-Aug	145	-0.23	0.00	6.05	-12.94	2.10	-1.31	11.93	523.07

4.2 Augmented Dickey-Filler Approach (ADF) test

This table provides the Augmented Dickey-Filler Approach (ADF) test for the Unit root to test with Intercept and trend the stationarity for the return series of ten commodities. Null hypothesis Futures return have unit root at 5% level of significance. The number of lags chosen automatically by using automatic selection function using this function the lag for the model is automatically selected using AIC, such that the best fit model has minimum AIC .The critical value of rejection of the unit root. The ADF test rejects the existences of a unit root in the time series of the daily returns of all the futures contracts. Hence the time series of the daily return can be analyzed in level there by conforming to the non-normality of the return series. Samuelson's hypothesis cannot be verified when the prices are non – stationary. So, we start on the empirical analysis with the stationary condition, under the phenomena of unit root tests. This can be tested by utilizing ADF tested with intercept and trend .the lag length was automatically selected using the automatic selection function using this function, the lag for the model is automatically particular using AIC, such that the finest acceptable model has minimum AIC, the outcome of stationary is test is described in the Table 3.The results of the stationary test (from the ADF t-value) that the volatility series did not contain a unit root, as the probabilities are smaller than 0.05 (5% significance level) for almost all the contracts the opinion that the volatility series do not contain any unit root, we remain testing the maturity effect by employing the time-varying models of ARCH and GARCH to elucidate the return instability over time.

Table: 4.3 Descriptive Analysis

This table provides the Augmented Dickey-Filler Approach (ADF) test for the Unit root to test with Intercept and trend the stationarity for the return series of ten commodities. Null hypothesis Futures return have unit root at 5% level of significance. The number of lags chosen automatically by using automatic selection function using this function the lag for the model is automatically selected using AIC, such that the best fit model has minimum AIC .The critical value of rejection of the unit root.

Contracts	Expiry Date	Automatic selection of lags based on AIC	Automatic selection Maximum lags	ADF(t-Value)	Probability
Nickel 2013	13-Aug	0	11	-11.53	0.000
	13-Sep	4	11	-3.39	0.055
	13-Oct	0	11	-11.45	0.000
Nickel 2014	14-Aug	1	11	-7.50	0.000
	14-Sep	4	12	-6.40	0.000
	14-Oct	0	12	-10.58	0.000
Copper 2013	13-Feb	0	13	-15.13	0.000
	13-Apr	0	14	-14.15	0.000
	13-Jun	0	13	-6.91	0.000
Copper 2014	14-Feb	0	14	-14.78	0.000
	14-Apr	0	13	-13.66	0.000
	14-Jun	0	13	-11.74	0.000
Crude oil 2013	13-Jun	0	13	-11.30	0.000
	13-Jul	0	13	-11.33	0.000
	13-Aug	0	13	-11.56	0.000

Table 4.3: Continued					
Contracts	**Expiry Date**	**Automatic selection of lags based on AIC**	**Automatic selection Maximum lags**	**ADF(t-Value)**	**Probability**
Crude oil 2014	14-Jun	0	12	-10.75	0.000
	14-Jul	0	12	-4.41	0.003
	14-Aug	0	12	-11.22	0.000
Silver 2013	13-May	1	14	-8.98	0.000
	13-Jul	10	13	-4.16	0.006
	13-Sep	0	13	-13.87	0.000
Silver 2014	14-May	1	14	-12.37	0.000
	14-Jul	0	14	-14.76	0.000
	14-Sep	9	14	-3.99	0.011
Aluminium 2013	13-Aug	0	11	-11.69	0.000
	13-Sep	0	11	-11.08	0.000
	13-Oct	0	11	-10.79	0.000
Aluminium 2014	14-Aug	0	11	-10.67	0.000
	14-Sep	0	12	-10.47	0.000
	14-Oct	0	11	-10.53	0.000
Natural Gas 2013	13-Aug	0	10	-9.95	0.000
	13-Sep	0	11	-8.60	0.000
	13-Oct	3	11	-9.61	0.000
Natural Gas 2014	14-Aug	0	10	-9.49	0.000
	14-Sep	3	11	-11.38	0.000
	14-Oct	0	11	-9.88	0.000
Zinc 2013	13-Aug	0	11	-8.19	0.000
	13-Sep	3	11	-11.38	0.000
	13-Oct	3	11	-11.36	0.000

Table 4.3: Continued					
Contracts	**Expiry Date**	**Automatic selection of lags based on AIC**	**Automatic selection Maximum lags**	**ADF(t-Value)**	**Probability**
Zinc 2014	14-Aug	0	11	-11.29	0.000
	14-Sep	0	12	-12.63	0.000
	14-Oct	0	12	-11.09	0.000
Gold 2013	13-Feb	0	13	-12.14	0.000
	13-Apr	0	13	-11.60	0.000
	13-Dec	0	13	-12.18	0.000
Gold 2014	14-Feb	0	13	-12.13	0.000
	14-Apr	8	14	-4.57	0.002
	14-Dec	0	13	-12.17	0.000
Lead 2013	13-Aug	0	11	-11.35	0.000
	13-Sep	0	11	-11.23	0.000
	13-Oct	0	11	-11.47	0.000
Lead 2014	14-Aug	0	11	-10.74	0.000
	14-Sep	0	12	-10.72	0.000
	14-Oct	1	12	-8.76	0.000
Potato 2013	13-Jun	0	11	-6.78	0.000
	13-Jul	1	10	-8.04	0.000
	13-Aug	0	11	-6.90	0.000
Potato 2014	14-Jun	0	13	-11.41	0.000
	14-Jul	0	13	-10.37	0.000
	14-Aug	0	13	-8.89	0.000

Significant when it is negative and probability of is <0.05

4.3 Parameter estimates table 4

We estimation ARMA (1, 1) GARCH (1, 1) model by using Bollersler-Wooldridge's Quire-maximum likelihood & using Berndt Hall-Hall-Hausman (BHHH) iterative algorithm as the optimization method. The estimation results of ARMA (1, 1)-GARCH (1, 1) model having time to maturity as a descriptive variable in the conditional variance equation are reported in table 4. The result of ARMA (1, 1) – GARCH (1, 1) having TTM as an explanatory variable (table 4). This table shows that there are 9(nine) contracts where the co-efficient on time to maturity, is negative and significant, thereby showing the presence of Samuelsson's hypothesis in their contracts. These are mainly: Nickel Oct 2013; Crude oil July 2013, Crude oil August 2013; Aluminium August 2013, Aluminium September 2013, Aluminium October 2013, Aluminium August 2014; Zinc August 2013.

Table 4.4 Parameter estimates of ARMA (1, 1)-GARCH (1, 1)

This table provides the ARMA (1, 1)-(GARCH (1, 1) estimates having time to maturity (T) as an explanatory variable in the conditional variance equation β_1 is the persistent coefficient used to measure the impact of past volatility on current volatilityα_1 is taken as shocks coefficient to measure the impact of recent news on volatility,δ_1Co-efficient is significant when it is negative and probability of δ_1 is <0.05. Samuelson's hypothesis to be correct the coefficient of volatility on maturity should be negative and (δ_1 <0) statistically significant.

Contract	**Expiry Date**	**Persistent**	**Coefficientβ_1**	**Probabilityβ_1**	**(T)Coefficientδ_1**	**Probabilityδ_1**
Nickel 2013	13-Aug	1.8483	1.0626	0.0000	-0.0017	0.0742
	13-Sep	1.1071	0.6740	0.0064	-0.0003	0.9004
	13-Oct	1.1915	1.1478	0.0000	-0.0003	0.0000
Nickel 2014	14-Aug	1.1961	1.1685	0.0000	0.0009	0.0000
	14-Sep	0.9628	0.4418	0.0164	0.0031	0.1380
	14-Oct	1.0731	1.0880	0.0000	0.0028	0.0000
Copper 2013	13-Feb	-0.1239	-0.4916	0.0000	0.7017	0.0000
	13-Apr	-0.0055	-0.5298	0.0000	0.0010	0.0000
	13-Jun	2.1546	-0.4755	0.0082	0.9864	0.0000
Copper 2014	14-Feb	4.8834	-0.4966	0.0000	0.0069	0.0000
	14-Apr	0.0911	-0.6424	0.0000	0.7569	0.0000
	14-Jun	-0.0313	-0.8088	0.0000	0.8939	0.0000
Crude oil 2013	13-Jun	0.8618	0.8452	0.0000	-0.0014	0.1301
	13-Jul	0.8166	0.8069	0.0000	-0.0028	0.0418
	13-Aug	0.9313	0.4314	0.0607	-0.0033	0.0128

Table 4.4 continued						
Contract	**Expiry Date**	**Persistent**	**Coefficientβ_1**	**Probabilityβ_1**	**(T)Coefficientδ_1**	**Probabilityδ_1**
	14-Jul	0.9781	0.2474	0.2443	-0.0006	0.2443
	14-Aug	0.7097	0.4773	0.1455	0.0013	0.1294
Silver 2013	13-May	1.0244	1.0584	0.0000	0.0029	0.0295
	13-Jul	0.9754	0.8470	0.0000	0.0029	0.0295
	13-Sep	1.1699	0.9496	0.0000	0.0003	0.8741
Silver 2014	14-May	0.4693	0.7117	0.0000	0.0011	0.0617
	14-Jul	0.9860	1.0010	0.0000	-0.0004	0.3072
	14-Sep	0.6825	0.9582	0.0000	0.0002	0.7834
Aluminium 2013	13-Aug	1.1964	1.1258	0.0000	-0.0029	0.0000
	13-Sep	1.1637	1.1240	0.0000	-0.0040	0.0000
	13-Oct	1.0918	1.1161	0.0000	-0.0002	0.0000
Aluminium 2014	14-Aug	1.3122	0.8887	0.0000	-0.0031	0.0314
	14-Sep	1.1623	0.9085	0.0000	-0.0003	0.9088
	14-Oct	0.8774	0.7068	0.0002	-0.0016	0.3510
Natural gas 2013	13-Aug	1.3135	1.1878	0.0000	-0.0059	0.0830
	13-Sep	1.0986	1.0981	0.0000	0.0011	0.7285
	13-Oct	0.8855	1.1967	0.0000	0.0038	0.0000
Natural gas 2014	14-Aug	4.0705	-0.1957	0.5379	0.0071	0.0000
	14-Sep	0.8644	0.7957	0.0091	-0.0013	0.8179
	14-Oct	1.0965	1.1275	0.0000	0.0042	0.2351
Zinc 2013	13-Aug	1.1000	1.0201	0.0000	-0.0036	0.0014
	13-Sep	0.9141	0.8457	0.0000	-0.0027	0.2472
	13-Oct	0.8184	0.7195	0.0000	-0.0017	0.2771

Table 4.4 Continued						
Contract	**Expiry Date**	**Persistent**	**Coefficientβ_1**	**Probabilityβ_1**	**(T)Coefficientδ_1**	**Probabilityδ_1**
	14-Sep	0.8633	-0.1096	0.1390	-0.0026	0.0658
	14-Oct	1.1089	1.0915	0.0000	-0.0008	0.4419
Gold 2013	13-Feb	0.8044	0.7236	0.0000	-0.0001	0.8112
	13-Apr	0.9512	0.9180	0.0000	0.0004	0.5274
	13-Dec	0.8740	0.7274	0.0000	-0.0010	0.1424
Gold 2014	14-Feb	1.0403	0.8875	0.0000	0.0001	0.8565
	14-Apr	1.0425	1.0594	0.0000	0.0000	0.0000
	14-Dec	0.7943	0.8888	0.0000	0.0000	0.9522
	13-Oct	0.9497	0.8154	0.0000	-0.0011	0.5446
Lead 2014	14-Aug	1.0950	0.5656	0.2479	-0.0027	0.1451
	14-Sep	1.1434	1.0735	0.0000	0.0001	0.0000
	14-Oct	1.1301	1.1466	0.0000	0.0009	0.1000
Potato 2013	13-Jun	1.1844	1.2535	0.0000	0.0037	0.0000
	13-Jul	1.2427	0.2898	0.1494	0.0075	0.0342
	13-Aug	1.3656	1.2182	0.0000	0.0048	0.0000
Potato 2014	14-Jun	1.5214	0.4151	0.1701	-0.0017	0.1984
	14-Jul	1.0257	0.7587	0.0000	0.0005	0.3766
	14-Aug	1.0065	0.7221	0.0000	-0.0021	0.2188

δ_1 Co-efficient is significant when it is negative and probability ofδ_1 is <0.05

4.4 Parameter estimates of table 4.5

The result of the enhanced ARMA (1,1) -GARCH (1,1) model having trading volume (VOL), open interest (OI) & time to maturity (TTM) as a regression in the conditional variance equation is summarized in table 5.However, the results of ARMA (1,1) GARCH (1,1) model having VOL, OI, TTM as an explanatory variable as given in table 5 showed evidence in favor of Samuelsson's hypothesis for 12 out of the total 60 contracts studied that means futures price volatility increases as the futures contract approaches its expiration and exhibited significant& negative value of $\delta_3$in the conditional variance equation. These twelve (12) contracts comprised of Nickel August 2014;Crude oil August 2013;Aluminium August 2014, Aluminium September 2014, October 2014; Natural Gas August 2013; Zinc September 2013, Zinc August 2013,Zinc September2014, Lead August2014, Lead September 2014; Potatoes Aug 13.

As for the trading volume, is concern it is negatively related to volatility for 5(five) contracts and positively related for 18(eighteen) contracts out of 60(Sixty) contracts studied. So, there is inconclusive evidence on the relation between volatility and trading volume. A substantial of contracts however, have negative relation with the volatility. On the other hand the other variable under study is Open Interest which has 15(fifteen) negative coefficients which fall under significant level and simultaneously 9 (nine) coefficients are positively significant which means out of 60 cases 24 coefficients are significant.

A total of 42 contracts shows significant values of GARCH co-efficient in ARMA (1, 1)-GARCH (1, 1) model having VOL, OI & TTM as explanatory variables. Comparing the degree of persistency over the two models, s we found that the degree of persistency reduced in a total of (42-16)26 contracts by including VOL, OI as additional explanatory variables in the conditional variance equation. Particularly the statistically significant GARCH co-efficient decreased in a total of 10 (decreasing comparing table 4 & table 5). As an example, the degree of persistency for nickel-2013 using ARMA (1,1)-GARCH (1,1) model having TTM as an explanatory variable as given in table 4 is 1.8483 which decreased to 1.2450 when calculated using ARMA (1,1)-GARCH (1,1) model having VOL,OI & TTM as explanatory

variables, as given in table 4.The GARCH coefficient for this particular contact in table 4 is 1.8483, which reduced to 1.0322 in table 5.Accordingly, our results suggest that the degree of persistency has reduced by including volume soak up the persistence of volatility to a greater extent than open interest, as evidenced by their higher coefficient values compared to the coefficient valves an open interest.

Table 4.5 Parameter estimates of ARMA (1, 1)-GARCH (1,1)

This table provides the ARMA (1,1)-(GARCH(1,1) estimates having, trading volume(T.V), open interest (O.I) and time to maturity as an explanatory variable in the conditional variance equation β_1 is the persistent coefficient used to measure the impact of past volatility on current volatilityα_1 is taken as shocks coefficient to measure the impact of recent news on volatility, $\delta_1$andδ_2 positive value indicates positive relationship between the trading volume and open interest with volatility and significant and negative significant value ofδ_3 that as TTM increases the volatility of futures prices decreases.δ_3Co-efficient is significant when it is negative and probability $\delta_3$of is <0.05

Contract	Expiry Date	Persistent	Coefficient β_1	Prob. β_1	Coefficient δ_1(T.V)	Prob. δ_1	Coefficient δ_2(O.I)	Prob. δ_2	Coefficient δ_3(T)	Prob. δ_3
Nickel 2013	13-Aug	1.2450	1.0322	0.0000	0.0000	0.0000	-0.0002	0.0000	0.0045	0.0002
	13-Sep	1.1380	0.5265	0.1354	0.0000	0.8975	0.0002	0.1879	-0.0069	0.1360
	13-Oct	1.1478	1.1144	0.0000	0.0000	0.2997	-0.0001	0.0000	0.0021	0.5183
Nickel 2014	14-Aug	1.2029	1.1761	0.0000	0.0000	0.0000	0.0000	0.0000	***-0.0006***	***0.0000***
	14-Sep	0.9407	0.4586	0.0118	0.0000	0.9014	0.0001	0.5293	0.0000	0.9902
	14-Oct	1.0552	1.0564	0.0000	0.0000	0.0000	0.0001	0.0000	0.0041	0.0000
Copper 2013	13-Feb	1.4921	0.1588	0.1702	-0.0059	0.5363	0.0058	0.0000	1.2446	0.0000
	13-Apr	0.5959	-0.0005	0.9957	0.0000	0.1165	-0.0009	0.0000	0.7397	0.0000
	13-Jun	17.0211	-0.1580	0.1196	-0.0001	0.0280	-0.0025	0.0000	1.2903	0.0000
Copper 2014	14-Feb	0.1587	0.1586	0.1686	-0.0001	0.5397	-0.0057	0.0000	0.0123	0.0000
	14-Apr	3.1950	-0.0718	0.0992	0.0000	0.0000	-0.0013	0.0000	0.8555	0.0000
	14-Jun	4.8031	-0.0466	0.0967	-0.0003	0.0007	-0.0026	0.0000	1.2659	0.0000
Crude oil 2013	13-Jun	0.8765	0.8631	0.0000	0.0000	0.3361	0.0000	0.1588	-0.0002	0.8734
	13-Jul	0.8344	0.8278	0.0000	0.0000	0.1348	0.0000	0.1582	-0.0017	0.2886
	13-Aug	0.9403	0.3959	0.1006	0.0000	0.8978	0.0000	0.3427	***-0.0049***	***0.0065***
Crude oil 2014	14-Jun	0.9030	0.6883	0.0411	0.0000	0.6793	0.0000	0.2488	0.0003	0.8505
	14-Jul	0.9669	0.2536	0.6932	0.0000	0.3936	0.0001	0.1485	-0.0013	0.1466
	14-Aug	0.9361	0.4682	0.1361	0.0000	0.7097	0.0000	0.9810	0.0000	0.9955

Table 4.5 continued

Contract	Expiry Date	Persistent	Coefficient β_1	Prob. β_1	Coefficient δ_1(T.V)	Prob. δ_1	Coefficient δ_2(O.I)	Prob. δ_2	Coefficient δ_3(T)	Prob. δ_3
Silver 2013	13-May	0.8015	0.0749	0.3102	0.0000	0.1545	-3.5000	0.3319	0.0010	0.4810
	13-Jul	0.9720	0.8506	0.0000	0.0000	0.7188	0.0000	0.2791	0.0054	0.0127
	13-Sep	1.1678	0.9489	0.0000	0.0000	0.8628	-0.0001	0.2731	0.0056	0.1560
Aluminium 13	13-Aug	1.0942	1.0213	0.0000	0.0001	0.3685	0.0000	0.0588	0.0011	0.7140
	13-Sep	0.9194	0.8682	0.0000	0.0003	0.3326	-0.0002	0.5461	-0.0024	0.5310
	13-Oct	1.0662	1.0590	0.0000	0.0001	0.3390	-0.0002	0.6088	0.0006	0.8733
Aluminium 14	14-Aug	1.1266	0.8955	0.0000	0.0000	0.0719	0.0000	0.8429	***-0.0068***	***0.0154***
	14-Sep	1.0983	0.9417	0.0000	0.0001	0.0225	-0.0001	0.4177	***-0.0052***	***0.0290***
	14-Oct	0.6335	0.6350	0.0000	-0.0001	0.0107	0.0004	0.0001	***-0.0143***	***0.0000***
Natural Gas13	13-Aug	1.2884	1.1932	0.0000	0.0000	0.0000	0.0001	0.0000	***-0.0240***	***0.0000***
	13-Sep	1.1393	1.0814	0.0000	0.0000	0.0005	0.0000	0.8747	-0.0050	0.3755
	13-Oct	1.0246	1.1025	0.0000	0.0000	0.0000	-0.0003	0.0000	0.0212	0.0000
Natural Gas 14	14-Aug	1.2221	1.1632	0.0000	0.0000	0.0000	-0.0003	0.0000	0.0364	0.0000
	14-Sep	1.4691	0.7956	0.0059	0.0000	0.9665	0.0000	0.7784	-0.0047	0.6820
	14-Oct	1.1276	1.1082	0.0000	0.0000	0.0000	0.0002	0.0000	0.0040	0.2425
Zinc 2013	13-Aug	1.0999	1.0159	0.0000	0.0000	0.7873	-0.0001	0.0007	-0.0013	0.1810
	13-Sep	1.1373	1.1263	0.0000	0.0001	0.0000	-0.0002	0.0000	***-0.0043***	***0.0000***
	13-Oct	0.8091	0.7345	0.0000	-0.0001	0.0354	0.0004	0.1630	-0.0051	0.3197
Zinc 2014	14-Aug	1.1540	0.9976	0.0000	0.0001	0.0148	0.0000	0.9508	***-0.0122***	***0.0008***
	14-Sep	0.8893	-0.1319	0.1336	0.0000	0.7448	0.0001	0.4477	***-0.0071***	***0.0185***
	14-Oct	0.8091	0.7345	0.0000	-0.0001	0.0354	0.0004	0.1630	-0.0051	0.3197
Gold 2013	13-Feb	0.8088	0.7299	0.0000	0.0000	0.9858	0.0000	0.4910	-0.0012	0.3986
	13-Apr	0.9002	0.8981	0.0000	0.0000	0.5920	0.0000	0.0884	0.0007	0.3778
	13-Dec	0.8740	0.7314	0.0000	0.0000	0.1562	0.0000	0.2404	-0.0008	0.4540

Table 4.5 Continued										
Contract	**Expiry Date**	**Persistent**	**Coefficient β_1**	**Prob. β_1**	**Coefficient δ_1(T.V)**	**Prob. δ_1**	**Coefficient δ_2(O.I)**	**Prob. δ_2**	**Coefficient δ_3(T)**	**Prob. δ_3**
	14-Apr	1.0476	1.0616	0.0000	0.0000	0.0000	0.0000	0.0000	0.0002	0.0000
	14-Dec	0.7914	0.8848	0.0000	0.0000	0.1984	0.0000	0.5506	0.0000	0.9063
Lead 2013	13-Aug	0.9425	0.7500	0.0041	0.0000	0.2807	-0.0001	0.0645	-0.0002	0.9549
	13-Sep	0.9223	0.8264	0.0000	0.0001	0.0002	0.0090	0.2556	0.5618	0.0499
	13-Oct	0.9300	0.8023	0.0000	0.0000	0.4562	0.0001	0.6829	-0.0073	0.2514
Lead 2014	14-Aug	1.0585	0.7449	0.0156	-0.0002	0.0632	-0.0011	0.0171	***-0.0125***	***0.0016***
	14-Sep	0.1990	0.9999	0.0000	0.0003	0.0000	-0.0011	0.0000	***-0.0006***	***0.5769***
	14-Oct	1.0539	1.0996	0.0000	0.0000	0.0000	-0.0001	0.0000	0.0011	0.0000
Potato 2013	13-Jun	1.1698	1.2488	0.0000	0.0006	0.0000	-0.0002	0.0000	0.0038	0.0000
	13-Jul	0.4043	0.3082	0.1364	-0.0020	0.5321	0.0016	0.3859	0.0042	0.5058
	13-Aug	1.3324	1.1916	0.0000	0.0007	0.0000	0.0005	0.0000	***-0.0015***	***0.0000***
Potato 2014	14-Jun	1.5706	0.3882	0.1734	0.0008	0.3707	0.0002	0.6428	-0.0060	0.1908
	14-Jul	1.0534	0.7820	0.0000	0.0010	0.5944	-0.0001	0.9342	-0.0002	0.8970
	14-Aug	1.0066	0.7233	0.0000	0.0004	0.9552	0.0002	0.9293	-0.0024	0.2314

δ_3 Co-efficient is significant when it is negative and probability ofδ_3 is <0.05

4.5 Summary of Analysis for the Samuelson's hypothesis

- In this thesis, we examined the relationship between the future price volatility and time to expiration, in the commodity derivative market of India. We empirically, investigated the Samuelson's (1965) hypothesis and Leverage effect using a GARCH model supports Samuelson's hypothesis propose that as the amount of information increase towards the maturity futures price volatility also increases as the contracts moves towards the expiry.
- Applying the GARCH model. We found that the Samuelson's hypothesis in the majority of commodities traded in MCX India does not hold true.
- This study concludes that the time to maturity, is not a major determinant of the futures price volatility in the commodity future market. In fact the Open Interest is equally stronger on the volatility compared to Time to maturity and trade volume.
- The result of the present study would be of interest to researchers and various market participants our finding suggests that the commodity Futures traders should not be biased in their decision solely on the basis of time-to- maturity.
- The study compares that the time to maturity, is not the significant cause of Futures price volatility.
- Apart from to time to maturity, there is positive and contemporaneous relationship of the trading volume and open interest in the futures markets where Open Interest dominates the Time to maturity and trading volume.
- Also, as the rate of information arrival proxy by the trading volume and open Interest having a stronger impact on the volatility of the Futures returns compared to time to maturity the margin requirement for the Future contract set by the clearing houses would depend on the rate of information arrival and would not be by Time -to -maturity.
- The investors and regulator can use the trading volume has an important source for predicting the margin requirement compared to the Time –to – maturity.

Table 4.6 Summary of Samuelson's Hypothesis for 60 contracts under study with the details of ADF, ARMA (1,1) – GARCH(1,1)for Examining the effect of Trading Volume, Open Interest and Time to Maturity on Volatility by testing the hypothesis. Concluding table 5 output & showing the analysis in favor of Samuelson's hypothesis and the explanatory variable impact at 5% level of significance.

Criteria	**No. of Contracts accepts Samuelson's hypothesis**	**Significant at 5%level**	**Commodities/Contracts**
1.The results of the stationarity test (ADF) showed the series did not Contains unit root as the probability are smaller than 0.05	60 accepted for stationarity		
2.Testing the Maturity effect by time varying models of ARMA(1,1)-GARCH(1,1)keeping T as the explanatory variable where the coefficient on TTM is negative and significant	9 Contracts accepted for Samuelson's hypothesis		Nickel Oct 2013, Crude oil July 2013,Aug2013 Aluminium Aug, Sept, Oct 13 Aug 14 Zinc Aug 2013 Lead Aug 2013
3. The total number of contract showed significant Values of GARCH coefficient in ARMA(1,1)-GARCH (1,1) model having trade volume, open Interest and Time to Maturity as explanatory Variable in favour of samuelson's Hypothesis			
• Trade volume		23 Contracts	Copper June 2013 & 2104 Aluminium Oct.2014 Zinc Oct 2013 & 2014 Potato June 2013

• Open Interest		24 Contracts	Nickel Aug ,Oct 2013 Copper April, June 13;Feb Apr, June 14 Silver Sept 2014 Natural Gas Oct,Aug2013 Zinc Aug Sept 2013 Lead Aug, Sept, Oct 2014 Potato June 2013
• Time to Maturity	12 Contracts accepted for Samuelson's hypothesis		Nickel Aug 2014 Crude oil Aug 2013 Lead Aug 2014 Potato Aug 2013 &2014 Aluminium Aug, Sept, Oct 2014 Zinc Aug, Sept 2013 & 2014, Natural Gas Aug 2013

4.6 Descriptive statistics of Co-integration

Table 6 presents the Descriptive statistics of the Spot and Future prices of sample commodities. According to the table that describes the sample descriptive statistics and variability of the Spot and also the Futures prices. The Minimum value of mean is 109.818 in commodity Aluminium price and maximum is 27464.56 in commodity Gold Spot price. The standard Deviation is Minimum in zinc at Futures worth at 1.9 and also the most variance is 9632.86 in Silver Futures prices. In terms of Co-efficient of variation for the commodities beneath study like Gold, Silver, Copper, Zinc, Nickel , Aluminium, Crude-Oil, Potato, Natural Gas, Lead whereas an outsized variability exist in Futures and Spot price across different commodities and conjointly between Futures and Spot prices of the same commodity ,variation is far more at the level out of the commodities analyzed ,Co-variance in Spot and Futures prices for the four commodities such as Copper with 4.9 as Spot and 4.8 at Futures; Zinc 9.8 in Spot and 9.6 in Futures; Aluminium 5.5 at Spot and 5.3 at Futures; Lead 9.2 for Spot and 9.6 at Futures which is less than 10 percent**.**

Table 4.7: Descriptive statistics for daily Spot and Futures prices

This table summarizes ten commodities traded at MCX India with descriptive statistics for daily Spot prices and Futures prices .The table details about the commodities Mean, Minimum Value, Maximum Value Standard Deviation, Co-efficient of Variation calculated in percentage t-statistics and P-Value with the significant value at 5 percent level.

Commodity	Mean	Minimum	Maximum	SD	CV (%)	*t-value*	*P-value*
Gold							
Spot Price	27464.56	19825.00	31355.00	3135.69	11.4	0.232	0.081
Futures Price	27459.30	19754.00	31262.00	3131.85	11.3		
Copper							
Spot Price	419.343	370.250	497.550	20.59	4.9	-5.725	0.000
Futures Price	420.705	369.850	494.450	20.35	4.8		
Silver							
Spot Price	49469.35	0.00	66340.00	9571.486	16	-0.184	0.854
Futures Price	49491.93	0.00	67856.00	9632.863	15.7		
Zinc							
Spot Price	110.352	106.45	113.950	2.039	9.8	-16.752	0.000
Futures Price	110.944	108.05	115.100	1.900	9.6		
Nickel							
Spot Price	971.316	0.00	1313.400	116.986	11.6	-15.519	0.000
Futures Price	976.498	0.00	1319.600	117.092	11.7		
Natural Gas							
Spot Price	202.649	0.00	382.000	47.884	23.2	-3.968	-0.000
Futures Price	203.272	0.00	386.200	48.029	23.1		
Crude Oil							
Spot Price	5310.754	0.00	7291.000	813.351	14.70	-2.66	0.000
Futures Price	5214.149	0.00	7507.000	812.431	14.66		

Table 4.7 Continued							
Commodity	Mean	Minimum	Maximum	SD	CV (%)	*t-value*	*P-value*
Aluminium							
Spot Price	109.818	0.00	134.400	7.685	5.5	-22.501	0.000
Futures Price	110.564	0.00	129.300	7.577	5.3		
Potato							
Spot Price	931.322	0.00	1385.700	321.276	28.2	-4.036	0.000
Futures Price	973.914	0.00	1485.000	302.780	30.3		
Lead							
Spot Price	118.794	0.00	149.500	11.476	9.2	-11.864	0.000
Futures Price	118.303	0.00	152.400	11.524	9.1		

Note: Significant at *0.05 level

4.7 ADF Test

As for the ADF of the level data is concerned, the tests rejects the null hypothesis of the unit root for Copper, Natural Gas, Silver, Aluminium, Potato, Nickel, and Lead. The Copper spot price is stationary and the Natural Gas's spot and future price are stationary Silver spot price is stationary Aluminium spot and futures price are stationary Potato spot and futures are stationary Nickel spot and Futures price are stationary and Lead spot and Futures prices both are stationary at level. All the remaining spot and future prices of Gold, Zinc and Nickel prices of spot and futures prices are nonstationary as suggested by the ADF test. Since the p-values are greater than 0.05 in case of the remaining commodities.

The result of unit root test for the major commodities by both the approaches where ADF test suggested that the Null hypothesis of a unit autoregressive root i.e. integration of order i(1) i.e. first difference unable to rejected the Null hypothesis for Gold, Zinc, Nickel, Crude oil and Potato Futures prices as they are non-stationary. But Null hypothesis for Copper, Silver, Aluminium, Potato spot price, Natural Gas and Lead where unit root hypothesis is stationary that means rejected the Null hypothesis where the significance value is ($p \leq 0.05$) for spot prices and for futures prices ($p \leq 10$) after testing the precondition of non-stationary time series of price information, co-integration test has been carried out to determine the existence of a long-run relationship between the Spot price and the Future price.

Table: 4.8 Unit root test on Spot and Futures prices of selected commodities

This table summarizes the report on the results from Augmented Dickey-fuller (ADF) at the level and 1st Difference and applied the Phillips Perron (PP) test at the level 5% and at the 1st Difference to test the stationarity and non-stationarity of the unit root on spot and Futures prices of selected commodities such as Gold, Silver, Copper, Zinc, Nickel , Aluminium, Crude-Oil, Potato, Natural Gas, Lead at 5 percent and 10 percent level of significance value in Parenthesis indicate MacKinnon (1996)*P*-Values

The Null Hypotheses Closing price has a Unit root (non-stationary)

Commodity	**Augmented Dickey-Fuller(ADF)**		**Phillips-Perron(PP)**	
	Level	**1st Difference**	**Level**	**1st Difference**
Gold				
Spot Price	-1.470(0.832)	-8.580* (0.000)	-1.503(0.821)	-8.558* (0.000)
Futures Price	-1.534(0.810)	-8.798* (0.000)	-1.517(0.816)	-8.789* (0.000)
Copper				
Spot Price	-3.757(0.198) **	-21.110* (.000)	-3.727(0.021) *	-21.142* (0.000)
Futures Price	-3.520(0.038)*	-21.591* (0.00)	-3.563(0.034) *	-21.647* (0.000)
Silver				
Spot Price	-6.733(0.000) *	-9.158* (0.000)	-6.702(0.000) *	-32.563* (0.000)
Futures Price	-6.916(0.000) *	-9.457* (0.000)	-6.924(0.000) *	-30.056* (0.000)
Zinc				
Spot Price	-1.218(0.883)	-5.645* (0.000)	-0.817(0.949)	-9.878* (0.000)
Futures Price	-0.652(0.965)	-9.051* (0.000)	-0.101(0.991)	-9.252* (0.000)
Nickel				
Spot Price	-2.665(0.251)	-26.600* (0.000)	-3.979(0.009) *	-70.357* (0.000)
Futures Price	-2.477(0.339)	-22.532* (0.000)	-4.000(0.008) *	-70.340* (0.000)

Table 4.8 continued				
Commodity	**Augmented Dickey-Fuller(ADF)**		**Phillips-Perron(PP)**	
	Level	**1st Difference**	**Level**	**1st Difference**
Natural Gas				
Spot Price	-3.032(0.123) **	-32.051* (0.000)	-4.075(0.000) *	-61.732* (0.000)
Futures Price	-3.063(0.115) **	-30.969* (0.000)	-4.048(0.000) *	-62.401* (0.000)
Crude Oil				
Spot Price	-1.837(0.684)	-19.186* (0.000)	-2.014(0.590)	-19.283* (0.000)
Futures Price	-2.176(0.500)	-20.048* (0.000)	-2.193(0.491)	-20.025* (0.000)
Aluminium				
Spot Price	-4.489(0.001) *	-21.005* (0.000)	-24.577(0.000) *	-168.827* (0.000)
Futures Price	-4.546(0.001) *	-21.059* (0.000)	-25.565(0.000) *	-175.823* (0.000)
Potato				
Spot Price	-4.991(0.00) *	-18.095* (0.00)	-5.910(0.00) *	-26.600* (0.00)
Futures Price	-2.731((0.22)	-20.418* (0.00)	-5.133(0.00) *	-37.752*(0.00)
Lead				
Spot Price	-3.756(0.019) *	-23.947* (0.00)	-11.397(0.00) *	-87.726* (0.00)
Futures Price	-2.845(0.052) *	-24.005* (0.00)	-11.462(0.00) *	-89.546* (0.00)

Note: Significant at *0.05 and **0.10 levels; value in parentheses indicate MacKinnon Haug-Michelis (1999) *p*-value

4.8 Co-integration test

Table 8 presents the residual vectors of the model construct two likelihood ratio test statistics, i.e. .the trace test and the maximal Eigen value test. The trace statistics test the null hypotheses of r=0 co-integration relations against alternative hypothesis of r≤1 co-integrating relations. The null hypothesis for the trace statistic sr =0 means no co-Integration (stationary) and Null hypothesis for the r≤1 means no unit root. This table presents the co-integration results from the application of the Johansen method of reduced rank regression using the vector error correction model. The Johansen $\boldsymbol{\lambda_{trace}}$ **and** $\boldsymbol{\lambda_{max}}$(maximal eigenvalue), analysis indicates that null hypothesis of non-co-integration (r=0) is rejected at 5% level of significance for all the commodities except Zinc. The null hypothesis of reduced rank, r≤1,cannot be rejected by both $\boldsymbol{\lambda_{trace}}$ **and** $\boldsymbol{\lambda_{max}}$statistics for most of the commodities for which null of r=0 is rejected,except potato at p<0.10.The rejection of reduced rank implies that the data series for these commodities are stationary, despite the earlier conclusion drawn from the unit roots. This implies that with increase in the Lag length, prices of these commodities becomes stationary. In this case the commodities could be excluded from further analysis. However, as the co-integration results may be sensitive to the lag length chosen in the model, hence these commodities for Crude Oil and Potato were not dropped while performing causality tests. The existence of Co-integration between the Spot and Futures prices confirms the first necessary condition for the long term market efficiency. Based on the co-integration analysis of futures and spot prices of ten commodities studied, further the commodities may be grouped into three categories no integration Zinc and co-integration Gold, Copper, Silver, Nickel, Natural Gas, Crude Oil, Aluminium, Potato and Lead.

Table 4.9: Johensen's co-integration model

This table reports the application of Johensen's method of Integration unit Vector error correction model such as $\lambda_{trace}$and p-value and Max-Eigen statistics with $\lambda_{max}$and p-value for the following commodities: Gold, Silver, Copper, Zinc, Nickel, Aluminium, Crude-Oil, Potato, Natural Gas, Lead with Spot prices and Futures prices at Significant at *0.05 and **0.10 levels; value in parentheses indicate MacKinnon Haug-Michelis (1999) *p*-values.

The Null Hypotheses for Trace statistics $r = 0$ no cointegration

The Null Hypotheses for trace statistics $r \leq 1$Closing price has a Unit root (non-stationary)

Commodities	Trace statistics		Max-Eigen Statistics	
	λ_{trace}	p-value	λ_{max}	p-value
Gold				
H_0:r = 0	37.478*	0.000	30.645*	0.000
H_0:r ≤ 1	6.833*	0.000	6.833*	0.008
Copper				
H_0:r = 0	94.122*	0.000	82.433*	0.000
H_0:r ≤ 1	11.688*	0.000	11.688*	0.000
Silver				
H_0:r = 0	40.455*	0.000	33.015*	0.000
H_0:r ≤ 1	7.298*	0.006	7.298*	0.006
Zinc				
H_0:r = 0	12.351	0.140	8.551	0.325
H_0:r ≤ 1	3.800*	0.051	3.800	0.051
Nickel				
H_0:r = 0	205.443*	0.000	199.209*	0.000
H_0:r ≤ 1	6.234*	0.012	6.234*	0.012

Table 4.9 continued

Commodities	Trace statistics		Max-Eigen Statistics	
	λ_{trace}	p-value	λ_{max}	p-value
Natural Gas				
H_0:r = 0	323.697*	0.000	319.566*	0.000
H_0:r ≤ 1	4.130*	0.042	4.130*	0.042
Crude Oil	28.002	0.004	25.848	0.000
H_0:r = 0	2.153	0.142	2.153	0.142
H_0:r ≤ 1				
Aluminium	172.262*	0.000	147.543*	0.000
H_0:r = 0	24.719*	0.000	24.719*	0.000
H_0:r ≤ 1				
Potato				
H_0:r = 0	50.360*	0.000	48.899*	0.000
H_0:r ≤ 1	1.460	0.226	1.460	0.226
Lead				
H_0:r = 0	155.027*	0.001	146.341*	0.000
H_0:r ≤ 1	8.685*	0.003	8.685*	0.003
95% critical value				
H_0:r = 0	15.494		14.264	
H_0:r ≤ 1	3.841		3.841	

Note: Significant at *0.05 and **0.10 levels; value in parentheses indicate MacKinnon Haug-Michelis (1999) *p*-values

4.9 Granger Causality tests

Table 9 Since co-integration test indicate only the existence of long run relationship among futures and Spot prices, Granger causality test are used to analyze the direction of relationship among series. Granger causality shows uni-directional causality where futures market prices lead the Spot prices for Gold, Aluminium, Zinc, Copper, and Natural Gas. This implies that the futures market discover prices for these commodities and Spot markets discover prices are influenced by the futures market prices. The Causality test for Silver, Potato, Nickel and Crude Oil is also uni-directional, where spot prices causes changes in futures market prices. The commodities such as Lead shows Bi-directional relationship between spot and futures market prices.

Table: 4.10 Granger Causality tests statistics for the selected Commodities

This table reports the application of Granger Causality test for the ten commodities where the null hypothesis for Futures returns does not granger cause spot returns and simultaneously spot returns does not Granger causes future return. The F-statistics and probability are used to check the hypothesis. Direction in the forms of Uni-directional, Bi-directional is used and relationship is being tested for futures effect on spot or spot effect on futures.

Commodity	Hypothesis	F-statistics	Probability	Direction	Relationship
Gold	FR does not Granger cause SR SR does not Granger Cause FR	1.656 0.713	0.197 0.493	Uni-directional	(F→S)
Copper	FR does not Granger cause SR SR does not Granger Cause FR	87.154 0.039	0.000 0.961	Uni-directional	(F→S)
Silver	FR does not Granger cause SR SR does not Granger Cause FR	1.888 7.016	0.158 0.001	Uni-directional	(S→ F)
Zinc	FR does not Granger cause SR SR does not Granger Cause FR	109.894 1.296	0.000 0.270	Uni-directional	(F→S)
Nickel	FR does not Granger cause SR SR does not Granger Cause FR	1.524 187.194	0.218 0.000	Uni-directional	(S→ F)
Natural Gas	FR does not Granger cause SR SR does not Granger Cause FR	681.559 0.239	0.000 0.786	Uni-directional	(F→S)
Crude Oil	FR does not Granger cause SR SR does not Granger Cause FR	2.419 205.459	0.089 0.000	Uni-directional	(S↔F)

Table 4.10 Continued

Commodity	Hypothesis	F-statistics	Probability	Direction	Relationship
Aluminium	FR does not Granger cause SR SR does not Granger Cause FR	142.249 1.948	0.000 0.143	Uni-directional	(F→S)
Potato	FR does not Granger cause SR SR does not Granger Cause FR	3.481 5.926	0.031 0.002	Uni-directional	(S→ F)
Lead	FR does not Granger cause SR SR does not Granger Cause FR	8.254 306.717	0.000 0.000	Bi-directional	(S↔F)

*****NOTE: SR means spot returns; FR means Futures return; →shows direction of relationship**

4.10 Causality Test

This table 10 describes about the co-integration and causality tests between Futures and spot prices, commodities have been placed in two by three matrix. Empirical findings suggest that there is a long term relationship between futures and spot prices for the majority of commodities Gold, Aluminium, Copper, and Crude Oil. This implies that future markets have enough ability to predict subsequent spot prices, i.e.to discover prices in spot market for these commodities.

The analysis of the short-term relationship by causality test indicates that futures markets have stronger ability to predict subsequent Spot prices for --- as compare to----- where bi-directional relationship exist in the short run with co-integrated and Uni-directional relationship ,where futures prices leads Spot market price. Non-existence of co-integration between futures and spot prices of Zinc with the uni-directional causality test where futures market prices lead to change in spot market prices, raises concern for the market efficiency as this trend may cause rise in spot prices of Zinc due to inefficient futures market.

Table 4.11: Categorization of commodities based on co-integration and causality test

This table represents the causality test based on the categorization of commodities. This table gives details on the Causality co-integration, uni-directional relation, Bi-directional relation

Causality co-integration	**Uni-directional (F→S)**	**Uni-directional (S→ *F*)**	**Bi-directional (S↔F)**
No co-integration	zinc	-----	-----
Co-integration	Gold, Aluminium, Copper, Natural Gas	Silver, Potato, Nickel Crude oil	Lead

Notes: S-spot prices; F- futures prices

Table: 4.12 Summary of Hypothesis Testing (at 0.05 level of significance)

Hypothesis	Rejected	Not Rejected
H_{O1}: There is no significant Effect of Nickel August 2013Trading Volume on Volatility	✓	
H_{O2}: There is no significant Effect of Nickel September 2013 Trading Volume on Volatility	✓	
H_{O3}: There is no significant Effect of Nickel October 2013 Trading Volume on Volatility	✓	
H_{O4}: There is no significant Effect of Nickel August 2014Trading Volume on Volatility	✓	
H_{O5}: There is no significant Effect of Nickel September 2014Trading Volume on Volatility	✓	
H_{O6}: There is no significant Effect of Nickel October 2014 Trading Volume on Volatility	✓	
H_{O7}: There is no significant Effect of Copper February 2013Trading Volume on Volatility	✓	
H_{O8}: There is no significant Effect of Copper April 2013Trading Volume on Volatility	✓	
H_{O9}: There is no significant Effect of Copper June 2013Trading Volume on Volatility		✓
H_{10}: There is no significant Effect of Copper February 2014 Trading Volume on Volatility	✓	
H_{11}: There is no significant Effect of Copper April 2014 Trading Volume on Volatility	✓	
H_{12}: There is no significant Effect of Copper June 2013 Trading Volume on Volatility		✓

H_{13}: There is no significant Effect of Crude oil June2013 Trading Volume on Volatility	✓	
H_{14}: There is no significant Effect of Crude oil July 2013 Trading Volume on Volatility	✓	
H_{15}: There is no significant Effect of Crude oil August 2013 Trading Volume on Volatility	✓	
H_{16}: There is no significant Effect of Crude oil June2014 Trading Volume on Volatility	✓	
H_{17}: There is no significant Effect of Crude oil July 2014 Trading Volume on Volatility	✓	
H_{18}: There is no significant Effect of Crude oil August 2014 Trading Volume on Volatility	✓	
H_{19}: There is no significant Effect of Silver May2013 Trading Volume on Volatility	✓	
H_{20}: There is no significant Effect of Silver July2013 Trading Volume on Volatility	✓	
H_{21}: There is no significant Effect of Silver September 2013 Trading Volume on Volatility	✓	
H_{22}: There is no significant Effect of Silver May 2014 Trading Volume on Volatility	✓	
H_{23}: There is no significant Effect of Silver July 2014 Trading Volume on Volatility	✓	
H_{24}: There is no significant Effect of Silver September 2014 Trading Volume on Volatility	✓	
H_{25}: There is no significant Effect of Aluminium August 2013 Trading Volume on Volatility	✓	

H_{26}: There is no significant Effect of Aluminium September 2013 Trading Volume on Volatility	✓	
H_{27}: There is no significant Effect of Aluminium October 2013 Trading Volume on Volatility	✓	
H_{28}: There is no significant Effect of Aluminium August 2014 Trading Volume on Volatility	✓	
H_{29}: There is no significant Effect of Aluminium September 2014 Trading Volume on Volatility	✓	
H_{30}: There is no significant Effect of Aluminium October 2014 Trading Volume on Volatility		✓
H_{31}: There is no significant Effect of Natural gas August 2013 Trading Volume on Volatility	✓	
H_{32}: There is no significant Effect of Natural gas September 2013 Trading Volume on Volatility	✓	
H_{33}: There is no significant Effect of Natural gasOctober 2013 Trading Volume on Volatility	✓	
H_{34}: There is no significant Effect of Natural gas August 2014 Trading Volume on Volatility	✓	
H_{35}: There is no significant Effect of Natural gas September 2014 Trading Volume on Volatility	✓	
H_{36}: There is no significant Effect of Natural gas October 2014 Trading Volume on Volatility	✓	
H_{37}: There is no significant Effect of Zinc August 2013 Trading Volume on Volatility	✓	
H_{38}: There is no significant Effect of Zinc September 2013 Trading Volume on Volatility	✓	

H_{39}: There is no significant Effect of Zinc October 2013 Trading Volume on Volatility		✓
H_{40}: There is no significant Effect of Zinc August 2014 Trading Volume on Volatility	✓	
H_{41}: There is no significant Effect of Zinc September 2014 Trading Volume on Volatility	✓	
H_{42}: There is no significant Effect of Zinc October 2014 Trading Volume on Volatility		✓
H_{43}: There is no significant Effect of Gold August 2013Trading Volume on Volatility	✓	
H_{44}: There is no significant Effect of Gold September 2013 Trading Volume on Volatility	✓	
H_{45}: There is no significant Effect of Gold October 2013 Trading Volume on Volatility	✓	
H_{46}: There is no significant Effect of Gold August 2014 Trading Volume on Volatility	✓	
H_{47}: There is no significant Effect of Gold September 2014 Trading Volume on Volatility	✓	
H_{48}: There is no significant Effect of Gold October 2014 Trading Volume on Volatility	✓	
H_{49}: There is no significant Effect of LeadAugust 2013 Trading Volume on Volatility	✓	
H_{50}: There is no significant Effect of Lead September 2013 Trading Volume on Volatility	✓	
H_{51}: There is no significant Effect of Lead October 2013 Trading Volume on Volatility	✓	

H_{52}: There is no significant Effect of Lead August 2014 Trading Volume on Volatility	✓	
H_{53}: There is no significant Effect of Lead September 2014 Trading Volume on Volatility	✓	
H_{54}: There is no significant Effect of Lead October 2014 Trading Volume on Volatility	✓	
H_{55}: There is no significant Effect of Potato June 2013 Trading Volume on Volatility		✓
H_{56}: There is no significant Effect of Potato July 2013 Trading Volume on Volatility	✓	
H_{57}: There is no significant Effect of Potato August 2013 Trading Volume on Volatility	✓	
H_{58}: There is no significant Effect of Potato June 2014 Trading Volume on Volatility	✓	
H_{59}: There is no significant Effect of Potato July 2014 Trading Volume on Volatility	✓	
H_{60}: There is no significant Effect of Potato August 2014 Trading Volume on Volatility	✓	
H_{61}: There is no significant Effect of Nickel August 2013 Open Interest on Volatility		✓
H_{62}: There is no significant Effect of Nickel September 2013 Open Interest on Volatility	✓	
H_{63}: There is no significant Effect of Nickel October 2013 Open Interest on Volatility		✓
H_{64}: There is no significant Effect of Nickel August 2014 Open Interest on Volatility	✓	

H_{65}: There is no significant Effect of Nickel September 2014 Open Interest on Volatility	✓	
H_{66}: There is no significant Effect of Nickel October 2014 Open Interest on Volatility	✓	
H_{67}: There is no significant Effect of Copper February 2013 Open Interest on Volatility	✓	
H_{68}: There is no significant Effect of Copper April 2013 Open Interest on Volatility		✓
H_{69}: There is no significant Effect of Copper June 2013 Open Interest on Volatility		✓
H_{70}: There is no significant Effect of Copper February 2014 Open Interest on Volatility		✓
H_{71}: There is no significant Effect of Copper April 2014 Open Interest on Volatility		✓
H_{72}: There is no significant Effect of Copper June 2014 Open Interest on Volatility		✓
H_{73}: There is no significant Effect of Crude oil June 2013 Open Interest on Volatility	✓	
H_{74}: There is no significant Effect of Crude oil July 2013 Open Interest on Volatility	✓	
H_{75}: There is no significant Effect of Crude oil August 2013 Open Interest on Volatility	✓	
H_{76}: There is no significant Effect of Crude oil June 2014 Open Interest on Volatility	✓	
H_{77}: There is no significant Effect of Crude oil July 2014 Open Interest on Volatility	✓	

H_{78}: There is no significant Effect of Crude oil August 2014 Open Interest on Volatility	✓	
H_{79}: There is no significant Effect of Silver May 2013 Open Interest on Volatility	✓	
H_{80}: There is no significant Effect of Silver July 2013 Open Interest on Volatility	✓	
H_{81}: There is no significant Effect of Silver September 2013 Open Interest on Volatility	✓	
H_{82}: There is no significant Effect of Silver May 2014 Open Interest on Volatility	✓	
H_{83}: There is no significant Effect of Silver July 2014 Open Interest on Volatility	✓	
H_{84}: There is no significant Effect of Silver September 2014 Open Interest on Volatility		✓
H_{85}: There is no significant Effect of Aluminium August 2013 Open Interest on Volatility	✓	
H_{86}: There is no significant Effect of Aluminium September 2013 Open Interest on Volatility	✓	
H_{87}: There is no significant Effect of Aluminium October 2013 Open Interest on Volatility	✓	
H_{88}: There is no significant Effect of Aluminium August 2014 Open Interest on Volatility	✓	
H_{89}: There is no significant Effect of Aluminium September 2014 Open Interest on Volatility	✓	
H_{90}: There is no significant Effect of Aluminium October 2014 Open Interest on Volatility	✓	

H_{91}: There is no significant Effect of Natural gas August 2013 Open Interest on Volatility		✓
H_{92}: There is no significant Effect of Natural gas September 2013 Open Interest on Volatility	✓	
H_{93}: There is no significant Effect of Natural gas October 2013 Open Interest on Volatility		✓
H_{94}: There is no significant Effect of Natural gas August 2014 Open Interest on Volatility	✓	
H_{95}: There is no significant Effect of Natural gas September 2014 Open Interest on Volatility	✓	
H_{96}: There is no significant Effect of Natural gas October 2014 Open Interest on Volatility	✓	
H_{97}: There is no significant Effect of Zinc August 2013 Open Interest on Volatility		✓
H_{98}: There is no significant Effect of Zinc September 2013 Open Interest on Volatility		✓
H_{99}: There is no significant Effect of Zinc October 2013 Open Interest on Volatility	✓	
H_{100}: There is no significant Effect of Zinc August 2014 Open Interest on Volatility	✓	
H_{101}: There is no significant Effect of Zinc September 2014 Open Interest on Volatility	✓	
H_{102}: There is no significant Effect of Zinc October 2014 Open Interest on Volatility	✓	
H_{103}: There is no significant Effect of Gold August 2013 Open Interest on Volatility	✓	

H_{104}: There is no significant Effect of Gold September 2013 Open Interest on Volatility	✓	
H_{105}: There is no significant Effect of Gold October 2013 Open Interest on Volatility	✓	
H_{106}: There is no significant Effect of Gold August 2014 Open Interest on Volatility	✓	
H_{107}: There is no significant Effect of Gold September 2014 Open Interest on Volatility	✓	
H_{108}: There is no significant Effect of Gold October 2014 Open Interest on Volatility	✓	
H_{109}: There is no significant Effect of Lead August 2013 Open Interest on Volatility	✓	
H_{110}: There is no significant Effect of Lead September 2013 Open Interest on Volatility	✓	
H_{111}: There is no significant Effect of Lead October 2013 Open Interest on Volatility	✓	
H_{112}: There is no significant Effect of Lead August 2014 Open Interest on Volatility		✓
H_{113}: There is no significant Effect of Lead September 2014 Open Interest on Volatility		✓
H_{114}: There is no significant Effect of Lead October 2014 Open Interest on Volatility		✓
H_{115}: There is no significant Effect of Potato June2013 Open Interest on Volatility	✓	
H_{116}: There is no significant Effect of Potato July 2013 Open Interest on Volatility	✓	

H_{117}: There is no significant Effect of Potato August 2013 Open Interest on Volatility	✓	
H_{118}: There is no significant Effect of Potato June 2014 Open Interest on Volatility	✓	
H_{119}: There is no significant Effect of Potato July 2014 Open Interest on Volatility	✓	
H_{120}: There is no significant Effect of Potato August 2014 Open Interest on Volatility	✓	
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H_{122}: There is no significant Effect of Nickel September 2013 time to maturity on Volatility	✓	
H_{123}: There is no significant Effect of Nickel October 2013 time to maturity on Volatility		✓
H_{124}: There is no significant Effect of Nickel August 2014 time to maturity on Volatility	✓	
H_{125}: There is no significant Effect of Nickel September2014 time to maturity on Volatility	✓	
H_{126}: There is no significant Effect of Nickel October 2014 time to maturity on Volatility	✓	
H_{127}: There is no significant Effect of Copper February2013 time to maturity on Volatility	✓	
H_{127}: There is no significant Effect Copper April 2013 of time to maturity on Volatility.	✓	
H_{128}: There is no significant Effect Copper June 2013 of time to maturity on Volatility.	✓	

H_{129}: There is no significant Effect Copper February2014 of time to maturity on Volatility.	✓	
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H_{131}: There is no significant Effect of Copper June 2014 time to maturity on Volatility.	✓	
H_{132}: There is no significant EffectofCrude oil June 2013 time to maturity on Volatility.	✓	
H_{133}: There is no significant Effect of Crude oil July 2013 time to maturity on Volatility.		✓
H_{134}: There is no significant Effect of Crude oil August 2013 time to maturity on Volatility.		✓
H_{135}: There is no significant Effect of Crude oil June 2014 time to maturity on Volatility.	✓	
H_{136}: There is no significant Effect of Crude oil July2014 time to maturity on Volatility.	✓	
H_{137}: There is no significant Effect of Crude August 2014 time to maturity on Volatility	✓	
H_{138}: There is no significant Effect of Silver May 2013 time to maturity on Volatility	✓	
H_{139}: There is no significant Effect of Silver July 2013 time to maturity on Volatility	✓	
H_{140}: There is no significant Effect of Silver September 2013 time to maturity on Volatility	✓	
H_{141}: There is no significant Effect of Silver May 2014 time to maturity on Volatility	✓	

H_{142}: There is no significant Effect of Silver July 2014 time to maturity on Volatility	✓	
H_{143}: There is no significant Effect of Silver September 2014 time to maturity on Volatility	✓	
H_{144}: There is no significant Effect of Aluminium August 2013 time to maturity on Volatility		✓
H_{145}: There is no significant Effect of Aluminium September 2013 time to maturity on Volatility		✓
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H_{149}: There is no significant Effect of Aluminium October 2014 time to maturity on Volatility	✓	
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H_{151}: There is no significant Effect of Natural gas September 2013 time to maturity on Volatility	✓	
H_{152}: There is no significant Effect of Natural gas October 2013 time to maturity on Volatility	✓	
H_{153}: There is no significant Effect of Natural gas August 2014 time to maturity on Volatility	✓	
H_{154}: There is no significant Effect of Natural gas September 2014 time to maturity on Volatility	✓	

H_{155}: There is no significant Effect of Natural gas October 2014 time to maturity on Volatility	✓	
H_{156}: There is no significant Effect of Zinc August 2013 time to maturity on Volatility		✓
H_{157}: There is no significant Effect of Zinc September 2013 time to maturity on Volatility	✓	
H_{158}: There is no significant Effect of Zinc October 2013 time to maturity on Volatility	✓	
H_{159}: There is no significant Effect of Zinc August 2014 time to maturity on Volatility	✓	
H_{160}: There is no significant Effect of Zinc September 2014 time to maturity on Volatility	✓	
H_{161}: There is no significant Effect of Zinc October 2014 time to maturity on Volatility	✓	
H_{162}: There is no significant Effect of Gold August 2013 time to maturity on Volatility	✓	
H_{163}: There is no significant Effect of Gold September 2013 time to maturity on Volatility	✓	
H_{164}: There is no significant Effect of Gold October 2013 time to maturity on Volatility	✓	
H_{165}: There is no significant Effect of Gold August 2014 time to maturity on Volatility	✓	
H_{166}: There is no significant Effect of Gold September 2014 time to maturity on Volatility	✓	
H_{167}: There is no significant Effect of Gold October 2014 time to maturity on Volatility	✓	

H_{168}: There is no significant Effect of Lead August 2013 time to maturity on Volatility		✓
H_{169}: There is no significant Effect of Lead September 2013 time to maturity on Volatility	✓	
H_{170}: There is no significant Effect of Lead October 2013 time to maturity on Volatility	✓	
H_{171}: There is no significant Effect of Lead August 2014 time to maturity on Volatility	✓	
H_{172}: There is no significant Effect of Lead September 2014 time to maturity on Volatility	✓	
H_{173}: There is no significant Effect of Lead October 2014 time to maturity on Volatility	✓	
H_{174}: There is no significant Effect of Potato June 2013 time to maturity on Volatility	✓	
H_{175}: There is no significant Effect of Potato July 2013 time to maturity on Volatility	✓	
H_{176}: There is no significant Effect of Potato August 2013 time to maturity on Volatility	✓	
H_{177}: There is no significant Effect of Potato June 2014 time to maturity on Volatility	✓	
H_{178}: There is no significant Effect of Potato July 2014 time to maturity on Volatility	✓	
H_{179}: There is no significant Effect of Potato August 2014 time to maturity on Volatility	✓	
H_{180}: The Spot price of Gold is not Co-Integrated with Future price of Gold		✓

H_{181}The Spot price of Copper is not Co-Integrated with Futures price of Copper		✓
H_{182}The Spot price of Silver is not Co-Integrated with Future price of Silver		✓
H_{183}The Spot price of Zinc is not Co-Integrated with Futures price of Zinc	✓	
H_{184}: The Spot price of Crude Oil is not Co-Integrated with Future price of Nickel		✓
H_{185}: The Spot price of Aluminium is not Co-Integrated with Future price of Natural Gas.		✓
H_{186}: The Spot price of Natural Gas is not Co-Integrated with Future price of Crude Oil.		✓
H_{187}: The Spot price of Lead is not Co-Integrated with Future price of Aluminium.		✓
H_{188}:The Spot price of Lead is not Co-Integrated with Future price of Potato		✓
H_{189}: The Spot price of Potato is not Co-Integrated with Future price of Lead		✓
H_{190}: Spot price of Gold has a unit root* non stationary	✓	
H_{191} : Future price of Gold has a unit root	✓	
H_{192}:Spot price of Copper has a unit root.	✓	
H_{193} : Future price of Copper has a unit root	✓	
H_{194}: Spot price of Silver has a unit root	✓	
H_{195} : Future price of Silver has a unit root	✓	
H_{196}:Spot price of Zinc has a unit root	✓	

H_{197} :Future price of Zinc has a unit root	✓	
H_{198}:Spot price of Nickel has a unit root	✓	
H_{199}:Futures price of Nickel has a unit root	✓	
H_{200}:Spot price of Natural Gas has a unit root	✓	
H_{201}: Futures price of Natural Gas has a unit root	✓	
H_{202} : Spot price of Crude oil has a unit root	✓	
H_{203}: Futures price of Crude oil has a unit root	✓	
H_{204}: Spot price of Aluminium has a unit root	✓	
H_{205}: Future price of Aluminium has a unit root	✓	
H_{206}: Spot price of Potato has a unit root	✓	
$H_{207}5$: Future price of Potato has a unit root	✓	
H_{208}: Spot price of Lead has a unit root	✓	
H_{209}: Future price of Lead has a unit root	✓	
H_{210}: FR of Gold does not Granger cause SR		✓
H_{211}: SR Gold does not Granger cause FR		✓
H_{212}: FR Copper does not Granger cause SR	✓	
H_{213} : SR Copper does not Granger cause FR		✓
H_{214} FR Silver does not Granger SR		✓
H_{215}: SR Silver does not Granger FR	✓	
H_{216}: FR Zinc does not Granger cause SR	✓	
H_{217}: SR Zinc does not Granger cause FR		✓
H_{218}: FR Nickel does not Granger cause SR		✓

H_{219}: SR Nickel does not Granger cause FR	✓	
H_{220} : FR Natural Gas does not Granger cause SR	✓	
H_{221}: SR Natural Gas does not Granger cause FR		✓
H_{222}: FR Crude Oil does not Granger cause SR		✓
H_{223}: SR Crude Oil does not Granger cause FR	✓	
H_{224}: FR Aluminium does not Granger cause SR	✓	
H_{225}: SR Aluminium does not Granger cause FR		✓
H_{226}: FR Potato does not Granger cause SR	✓	
H_{227}: SR Potato does not Granger cause FR	✓	
H_{228}: FR Lead does not Granger cause SR	✓	
H_{229} SR Lead does not Granger cause FR	✓	

Chapter: 5 Conclusion and Implications

Chapter: 5

Conclusion and Implications

This chapter pulls together the major findings of the study and presents the conclusions. Further it points out the implications of the study and highlights the areas of further research.

5.1 Finding and conclusion based on ADF for Samuelson's Hypothesis

Samuelson's hypothesis cannot be verified when the prices are non – stationary. So, to start on the empirical analysis with the stationary condition, under the phenomena of unit root tests. This can be tested by utilizing Augumented Dickey Fuller (ADF) tested with intercept and trend. The lag length was automatically selected using AIC, such that the finest acceptable model has the minimum AIC. The results of the stationarity test (from the ADF t-value) showed that the volatility series did not contain a unit roots, as the probabilities are smaller than 0.05 (5% significance level) for almost all the contracts the same results are reported by Walls (1999) and Allen and Cruikshank (2000).Similarly, Pati (2006) is of the opinion that the volatility series do not contain any unit root, so we tested the maturity effect by employing the time-varying models of ARCH and GARCH to elucidate the volatility and time to maturity relation over time.

5.2 Finding and conclusion based on ADF for Johnson's co-integration:

As for the ADF of the level data is concerned, the tests rejects the null hypothesis of the unit root for Copper, Natural Gas, Silver, Aluminium, Potato, Nickel, and Lead. The Spot price of Copper, Natural gas, Silver, Aluminium, Potato, Nickel, and Lead are stationary at the levels.

Similarly the Futures prices of Natura gas Aluminium, Potato, Nickel and Lead are also stationary. All the remaining product's prices like Gold, Zinc and Nickel are non-stationary as suggested by the ADF test since the p-values are greater than 0.05.

The ADF test is unable to reject the null hypothesis of unit root for few commodities including Gold, Zinc, Nickle, and Crude Oil. And the ADF test rejects the null hypothesis of unit root for Copper, Silver, Aluminium, Potato, Natural Gas, and Lead. In these cases, unit root hypothesis is accepted for the spot prices ($p \leq 0.05$) and futures prices ($p \leq 0.05$). After testing the precondition of non-stationarity of time series of

prices, co-integration test has been carried out to determine the existence of a long-run relationship between the Spot price and the Future price. Moreover, the Granger-causality has been tested between Spot and Future prices to ascertain the short-term relation among them.

5.3 The Samuelson's hypothesis is first being summarized to have proper understanding of its application and analysis in this research

1. Modeling and predicting return volatilities of commodity futures is valuable for personnel concerned with risk management decisions. Forecasting volatilities over long horizons helps to deal with the issues related to the large engagement of resources e.g. raw materials for industries, agricultural produces, etc. Predictions are subject to errors, but it is apparent that more accurate the prediction is, the more and more benefits one can realize from them in the future. For this very reason, a decision maker involved in managing risk needs to understand the dynamics of different forecasting models as well as understand the consequences associated with the vague predictions
2. It is known that the futures markets exhibit innate risk. Towards the beginning of a futures contract, it is very difficult to collect precise information about the Future spot prices, but as the contract approaches towards its maturity, the rate of information acquisition increases.
3. Accordingly, when the delivery of the futures contract is far, any new information may or may not reflect into prices. But when delivery date is near, any new information will definitely affect the prices as there isn't any further time left to adjust the new information. This is the fundamental conjecture behind the maturity effect.
4. Examining the relationship between the volatility of futures prices and time to maturity, Samuelson in 1965proposed that volatility of futures prices increases as the contract approaches its maturity (expiration of the contract). Samuelson assumed that viable forces in the futures market cause Spot and Futures price to converge towards the expiration of the contract. The insight of such a hypothesis is principally explained by relating futures price volatility with the extent of information accessible in a market.

5. In simple words, Samuelson's hypothesis entails that the variance of the future price of a contract should be more towards its expiration. Predicting futures price volatility, in view of Samuelson's hypothesis, is very useful for traders, hedgers as well as for those taking part in the futures markets. The relation of the futures price volatility and the maturity is essential for setting the margin requirements in the futures markets. The margin required for trading is directly related to the futures contract price volatility.
6. Hedgers should choose futures contracts with either short or long horizons to maturity. Thus hedging strategies should be adjusted as maturity advances. When the Samuelson hypothesis holds, hedgers may prefer switching to contracts further away from expiration day; otherwise, they face higher volatility and require a higher risk premium. Unlike hedgers, speculators would like to trade during periods of high volatility. High volatility provide liquidity in the market and consequently enable speculators to earn large short-term returns.
7. Though numerous studies have empirically investigated the Samuelson's hypothesis in various international debts, equity, commodity and several other markets; but till date no significant work has been carried out in the commodity derivatives markets of India.

The following results are evident from this study

1. In view of the above regarding the Samuelson's maturity hypothesis, it appears that it does not hold good for most of the commodities studied, as significant and negative coefficient of time-to-maturity existed for only9 commodity contracts out of 60 contracts studied. The commodity contracts where Samuelson's hypothesis hold true are: Nickel Oct 2013; Crude oil July 2013, Crude oil August 2013; Aluminium August 2013, Aluminium September 2013, Aluminium October 2013, Aluminium August 2014; Zinc August 2013 and Lead August 2013. The relation between time-to-maturity and volatility has been investigated using the GARCH (1,1) model with time to maturity as the only exogenous variable .After including trading volume and Open Interest as explanatory factors of volatility, the results of the time-to-maturity significantly deviated from the previous result.

2. A significant and negative coefficient of time-to-maturity was observed for twelve (12) commodity contracts. These twelve contracts comprised of Nickel August 2014;Crude oil August 2013;Aluminium August 2014, Aluminium September 2014, October 2014; Natural Gas August 2013; Zinc September 2013, Zinc August 2013,Zinc September 2014, Lead August 2014, Lead September 2014; Potatoes Aug 13. However, the inclusion of trading volume and open interest in the conditional variance equation indicates declining persistency in the GARCH model. This clearly shows the importance of time to maturity and open interest as key determinants of the volatility.
3. The present study examined the relationship between futures price volatility and time to expiration, in the commodity derivatives markets of India. The researcher empirically investigated the Samuelson (1965) hypothesis using GARCH models. Supporters of Samuelson's hypothesis propose that as the amount of information increases towards maturity, futures price volatility also increases as the contract moves towards expiry. After applying the models, researcher found that Samuelson's hypothesis does not hold good in the majority of the commodities traded in MCX India. The study concludes that the time to maturity is not a significant determinant of Futures price volatility in the majority of commodity markets. In fact the open interest, also have much stronger effect on the volatility compared to time-to-maturity.
4. Our results show the support in favor of Samuelson's hypothesis in cases of Nickel, Crude Oil, Aluminium, Zinc, Lead (5 out of 10) during the considered time period. Our results are useful for market participants, clearing houses, regulators and investors in developing trading strategies in commodity derivative markets of India. As, there is not any strong support for the Samuelson's hypothesis in the commodity derivative markets of India, the decisions of the market participants should not be based solely on the volatility and time-to-maturity relationship.
5. Supporters of Samuelson's hypothesis propose that as the amount of information increases towards maturity, futures price volatility also increases as the contract moves towards expiry. Applying the models, we found that the Samuelson's hypothesis in the majority of commodities

traded on MCX, India does not hold true. The study concludes that the time to maturity is not a major determinant of futures price volatility in the commodity futures market.

6. In fact the trading volume has a much stronger effect on the volatility compared to open interest and time to maturity. Samuelson Hypothesis holds true in informational efficient futures market. Argument pertaining to the connection amid volatility of near and far contracts, we conclude that the relationship depends on the volatility parameter. The results of the present study would be of interest to researchers and various market participants.
7. Trading volume and open interest have also been considered as explanatory variables for the volatility. The results however are inconclusive. As for the trading volume, it is negatively related to volatility for 5(five) contracts and positively related for 18(eighteen) contracts out of 60(Sixty) contracts studied. So, there is inconclusive evidence on the relation between volatility and trading volume. A substantial number of contracts however, have negative relation with the volatility (18).
8. The other variable under study is Open Interest. It has 15(fifteen) negative coefficients which fall under significant level and simultaneously 9 (nine) coefficients are positively significant which means out of 60 cases 24 coefficients are significant. Thus, open interest is also a determinant of volatility but not the sole factor as reflected by its low number of significant coefficients.

5.4 Findings and conclusions based on Johnson's co-integration & causality tests:

1. As for the co-integration is concerned, all of the commodities Futures' and Spot prices are co-integrated except Zinc, which implies that in long-run these prices are related to each other. In other words, market participants can make abnormal profits by using trading strategies and exploiting the fact that the prices are co-integrated. As for Zinc, there is no co-integration between its Future prices and the Spot prices, this implies that Futures market of Zinc is efficient in India.

2. The findings from the Granger-causality have some important implications for market participants and policymaker. The Granger-causality test shows that, the direction of causality is stronger for Futures to Spot prices in general, especially the direction of causality is stronger for Futures to Spot prices in case of four commodities namely Gold, Aluminium, Copper, Natural Gas and Zinc suggesting that futures prices tend to affect Spot prices in the short run for these commodities. On the contrary, there is Spot to Futures causality for four commodities i.e. Silver, Potato, Nickel, and Crude Oil. The above results are diverging and hence, it is difficult to decide in favor of any particular direction for causality. In addition, there is bi-directional causality between Futures and Spot prices of Lead. It can be concluded that the causality is specific to the particular commodity under question.
3. The presence of Granger-causality between Futures' and Spot prices provides an opportunity to arbitrageurs to make profits.
4. In line with the ongoing global and domestic reforms in agriculture and allied sectors, the Indian Government is reducing its direct market intervention and encouraging private participation based on market forces. This has led to increased exposure of agricultural produce to price and other market risks, which consequently emphasize the importance of futures markets for price discovery and price risk management. The purpose of this study was to analyze the efficiency of futures agricultural and non-agricultural commodity markets by assessing the relationships between futures prices and spot market prices of major agricultural commodities in India.
5. Results show that co-integration exists significantly in Futures and Spot prices for commodities such as Gold, Aluminium, Copper, Natural Gas, Lead, Silver, Potato, Nickel, and Crude oil. A short-term divergence of either of the prices from the other price thus can be exploited by arbitrageurs. In the case of Zinc, its Future prices and Spot prices are not co-integrated. This suggest that there is no long-term relationship between Futures and Spot prices for Zinc. This implies that Futures market of Zinc is efficient in India and arbitrageurs cannot make abnormal profits using it. It is better for the investors to explore the markets of the above commodities other than that of Zinc to search for the abnormal profits.

6. The causality test further distinguishes and categorizes the commodities based on direction of causality between Futures and Spot prices. Investors can hedge the risk by looking at the direction of the effect. If Future prices are Granger-causing Spot prices then a change in Future prices can provide a signal for the change in spot prices. A short run relation exists between the Future and Spot prices of Gold, Aluminium, Copper, and Natural Gas and the direction of causality is from Futures to Spot. In other words, Futures prices have stronger ability to predict subsequent Spot prices.
7. The Granger-causality test shows that in the case of Lead the relation is bi-directional. Both the Spot and Future prices are Granger-causing each other. The stakeholders can either ways play the game and reap the fruit of the high quantity return with smart Investment
8. On the other hand, when the situation is reversed where Spot prices have effect on Futures' prices, there are four such commodities: Silver, Potato, Nickel and Crude oil. There is a short-term relationship among them as revealed by the Granger-causality test and the direction of causality is from Spot to Futures. In other words, Spot markets have strong ability to predict subsequent Futures' prices. The results of this study are useful for various stakeholders active in agricultural commodities markets such as producers, traders, commission agents, commodity exchange participants, regulators and policy makers by and large for protecting themselves from unforeseen risk.

Table 5.4.1: This table presents the summarized results of the Johnson's co-integration and Granger causality tests.

No. of Commodities	**Effects of spot and futures**	**Commodities under study**
1	No co-integration	Zinc
9	Existence of co-integration	Gold, Aluminium, Copper, Natural Gas, Silver, Potato, Nickel, Crude oil, Lead
4	Futures effect on Spot in short run (Uni-directional)	Gold, Aluminium, Copper, Natural Gas
1	Futures effect on Spot and Spot effect on Futures(Bi-directional)	Lead
4	Spot effect on Futures (Uni-directional)	Silver, Potato, Nickel Crude oil

5.5 Implications of the study

1. In this thesis, we examined the relationship between the future price volatility and time to expiration, in the commodity derivative market of India. We empirically, investigate the Samuelson's (1965) hypothesis using an ARCH model. Samuelson's hypothesis proposes that as the amount of information increases towards the maturity, futures price volatility also increases as the contracts moves towards the expiry. The implication of this conclusion is that the investors should seek additional variables for explaining the volatility.
2. Applying the GARCH model, we found that the Samuelson's hypothesis in the majority of commodities traded in MCX India does not hold true. This study concludes that the time to maturity, is not the sole determinant of the futures price volatility in the commodity future market. In fact, the trading volume has a much stronger effect on the volatility compared to open interest and time to maturity. Under these conditions trading volume can also be used to predict future volatility.
3. The result of the present study would be of interest to analysts and various market participants. Our finding suggests that the commodity futures traders should not base their decision solely on the basis of time-to- maturity. The study compares that the time to maturity, is not a major cause of futures price volatility.
4. The investors and regulator can use the trading volume as an important source for predicting the margin requirement compared to the Time –to – maturity.
5. In commodities where cointegration exists investors can make abnormal profit by exploiting short term deviance of spot prices from future prices.
6. In commodities whose spot and future prices are not co-integrated, investors cannot make abnormal profits.

5.6 Direction for future research

1. The track to look at the BCSS (Bessembinder, Coughenour, Seguin and Smoller) hypotheses that explains the negative covariance between Spot price and net cost of carry that explains the maturity impact can further be carried

forward with different commodities in different exchanges at the national or international levels.

2. Researchers mostly concentrate on limited agricultural commodities and it can be further extended to incorporate a range of agricultural and alternative commodities to check the impact of seasonality, inventory level both current as well as future inventory in testing the maturity impact.
3. It can further be examined as whether a trading strategy based on the Futures can be exploited in practical or not.
4. It is generally espoused that Futures market increases the efficiency of the market. It can be investigated as how the introduction of Futures in a particular commodity or equity affects its prices, liquidity, and efficiency.

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FUTURES AND SPOT PRICES WITH REFERENCE TO MCX METAL-A STUDY

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ABSTRACT
Derivatives markets in India have been in existence in one form or the other for a long time. In the area of commodities, the Bombay Cotton Trade Association started futures trading way back in 1875. In 1952, the Government of India banned cash settlement and options trading. Derivatives trading shifted to informal forwards markets. In recent years, government policy has shifted in favor of an increased role of market-based pricing and less suspicious derivatives trading. The first step towards introduction of financial derivatives trading in India was the promulgation of the Securities Laws (Amendment) Ordinance, 1995. It provided for withdrawal of prohibition on options in securities. The last decade, beginning the year 2000, saw lifting of ban on futures trading in many commodities. Around the same Period, national electronic commodity exchanges were also set up. Derivatives trading commenced in India in June 2000 after SEBI granted the final approval to this effect in May 2001 on the recommendation of L. C Gupta committee. Securities and Exchange Board of India (SEBI) permitted the derivative segments of two stock exchanges, NSE and BSE, and their clearing house/corporation to commence trading and settlement in approved derivatives contracts. Initially, SEBI approved trading in index futures contracts based on various stock market indices such as, S&P CNX, Nifty and Sensex. Subsequently, index-based trading was permitted in options as well as individual securities.

Key Words: futures, spot, MCX mcxmetal index, regression correlation

INTRODUCTION
A futures contact is a binding, legal agreement to buy (take delivery) or sell (make delivery of) a commodity. The terms of a futures contract are standardized by type (corn, wheat etc), quantity, quality, and delivery time and place. The variable portion of the contract is the price, determine at the time of trade in a process called price discovery that takes place on trading floor. Derivatives is useful for reducing many of the risks history of financial markets has evidence to suggest that when risk management avenues are provided by means of derivatives, markets attract higher volumes of investments from savers, strengthening the markets in the process.. Derivatives products serve the vitally important economic functions of price discovery and risk management. The transparency, which emerges from their trading mechanism, ensures the discovery in the underlying market. Further, they serve as risk management tools by facilitating the trading of risks and get rid of undesirable undertones. To facilitate the development of derivatives market, it is necessary to educate the market participants /investors on the hints of these new age products and their strategic use. In this regards, the role of SEBI, stock exchanges and its member participants is very much needed. To keep speed with inevitable and persistent uncertainty, today's investors must understand the basics of derivatives. Derivatives serve as tools for managing risk when used judiciously and cautiously. At present six National Level Commodity Exchanges in India are working. These are:

(i) National Multi Commodity Exchange of India (NMCE),

(ii) National Commodity Derivatives Exchange Ltd. (NCDEX),

(iii) Multi Commodity Exchange of India Ltd.(MCX),

(iv) Indian Commodity Exchange Ltd(ICEX),

(v) Ahmedabad Commodity Exchange(ACE),

(vi) Universal Commodity Exchange, Mumbai (UCE)

Futures trading characteristics:

(i) The commodity should have a suitable demand and supply conditions i.e. volume and marketable surplus should be large.

(ii) Prices should be volatile to necessitate hedging through futures trading in this case persons with a spot market commitment face a price risk. As a result there would be a demand for hedging facilities.

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(iii) The commodity should be free from substantial control from Govt. regulations (or other bodies) imposing restrictions on supply, distribution and prices of the commodity.

The commodity should be homogenous or, alternately it must be possible to specify a standard grade and to measure deviations from that grade. This condition is necessary for the futures exchange to deal in standardized contracts.

DEVELOPMENT OF COMMODITY FUTURES

"Agricultural commodities constituted a significant proportion of total value of trade till 2005-06. This place was taken over by Bullion and other Metals in 2006-07. Further, there has been a fall in agri-commodity volumes during 2007-08 over the 2006-07. Negative sentiments have been created by the decision to de-list futures trade in some important agricultural commodities. "During the year 2009-10(up to December2009), value of trade in agricultural commodities was about 16.33 per cent. Agricultural commodities, however, accounted for 38 per cent of the total volume of trade."12 In value terms, bullion accounted for the maximum share of commodity groups followed by energy and metals. It means various delisting of agri commodities was responsible for the poor growth of the poor trading of agri commodities. De-listing has adversely affected market sentiment regarding futures trading more generally; this must be because of the "go-stop" nature of government policy on the matter.

OBJECTIVES OF STUDY

1) To study the relationship between the future and the spot market during 2005 till 2014.

2) To study and analyze the performance of future and spot price movement during 2005 -2014.

REVIEW OF LITERATURE

Mamta jan et.al. 2014: According to their study it emphasizes on finding out the relationship between future prices and spot prices of selected agricultural commodity Black Pepper by applying Co-integration test using secondary data of 59 futures contracts for the period of 5 years from June 2008 to May 2013. On the basis of this study, conclusion has been drawn that is a co-integration between future and spot prices of agricultural Commodity Black pepper.

Prashanta athma et.al (2013):According to their studies which reveals that the average Futures prices are greater than the average Spot prices due to the fact that the Comdex is a combination of perishable and non-perishable commodities. They have notice that Futures showed the leadership in the markets, with the help of multiple Regression, and with similar results are being shown with Vector Error Correction model and the Granger Causality. Finally they are of the opinion that the market are efficient and availability of Comdex for the trading can enable the market participants to hedge their risk.

Harwinder et.al (2013): According to his analysis there is drastic change in the commodity futures market since its inception in terms of volume of trade and numerous product combination available for the investors .According to him commodity futures market playing two very important functions of the economy the first one is the price discovery and risk management, which again provides the liquidity and help in hedging future price risk. Secondly it further develop the field of electronic warehouse receipt which definitely proof to be commodity market the strengthen the Indian economy.

Kushankur Dey et.al (2012): According to their study market has witnessed phenomenal growth in terms of products on offer, trade volume, participation, and three-dimensional distribution. Pepper has been selected as a commodity to explore the price discovery. Some light on existing methods of price discovery mechanism through some perceptive implications from futures to spot prices has been observed in the Indian pepper futures market. However, the adjustment of innovations or surprises in the futures market is relatively faster than that of the spot market.

Sanjay Sehgal et.al. (2012):They studied the price discovery relationship for ten agricultural commodities. Price discovery results are encouraging given the blossoming atmosphere of commodity market in India. However the market does not seem to be competitive. Their findings have inferences for policy makers, hedgers and investors and will help in deeply understanding the role of futures market in information spreading. Forwards Market Commission (FMC) should be given adequate powers to regulate commodity market and punish any insider trading and price manipulations. Well-organized, electronically traded spot markets and well testing labs must be developed, ensuring transparency and trading efficiency should be established to strengthen the derivative market trading mechanism for efficient price discovery mechanism.

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RESEARCH METHODOLOGY

The following methodology has been adopted.

i) Research Design

The proposed work is based on empirical study and the research is descriptive and explanatory in nature.

ii) Data Collection

The secondary data has been collected from authentic websites of mcx. The closing future price of the commodity under observation has been taken.

iii) Tools for the Study

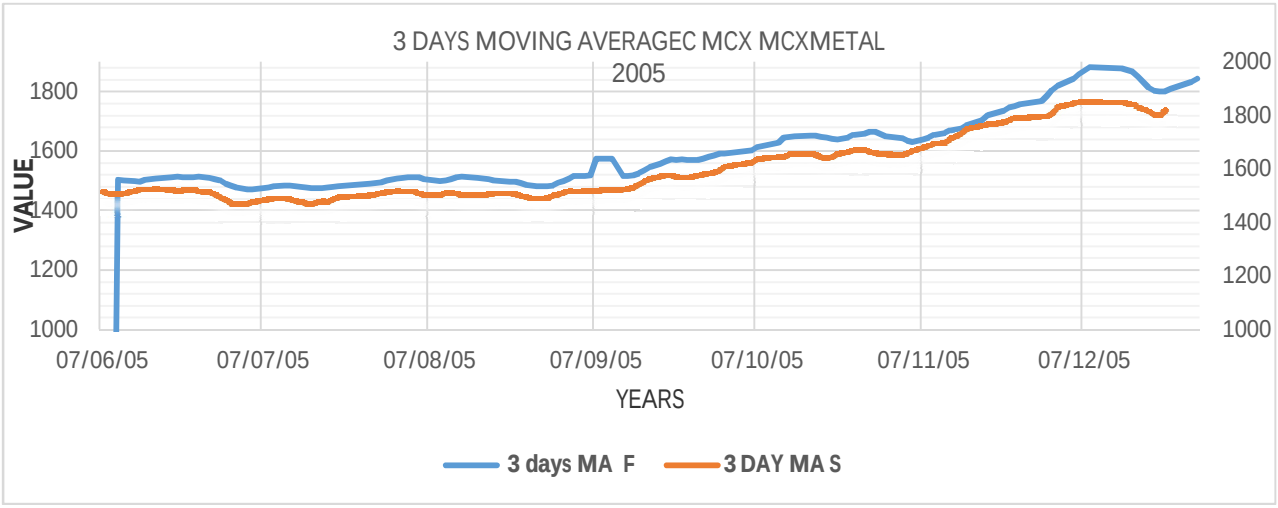
Moving Averages, multiple Regression, Correction

iv) Scope of the Study

There are various indices of commodity are available like MCX COMDEX , MCX METAL MCX ENERGY,MCX AGRI rainfall etc. for better comparison and analysis only MCXMETAL have been taken in the analysis. i.e. 2005-2014 only for nine years. Under commodity derivatives forward, future, option and swap many other are available but focus of this research is on the future and spot commodity prices.

DATA ANALYSIS AND INTERPRETATION

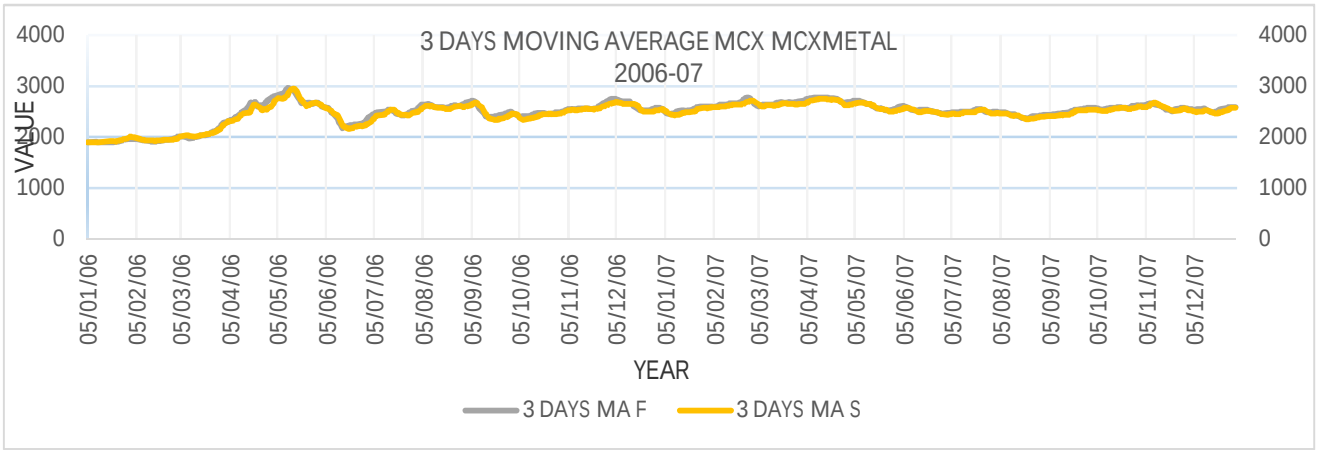
Chart - 1



Source: calculated from the MCXMETAL data from www.mcxindia.com

Interpretation: The graph for the period 2005 in chart 1 indicate a very close proximity between the movement of the future and spot prices. Where spot was prominent in leading the future at certain point of time otherwise both the markets are closely dominating each other.

CHART - 2



Source: calculated from the MCXMETAL data from www.mcxindia.com

In 2006-2007 (chart 2) it is clearly seen that futures and spot prices reveal that futures leads the spot more number of times whereas we can conclude that both are markets are moving in the same direction with slight variation.

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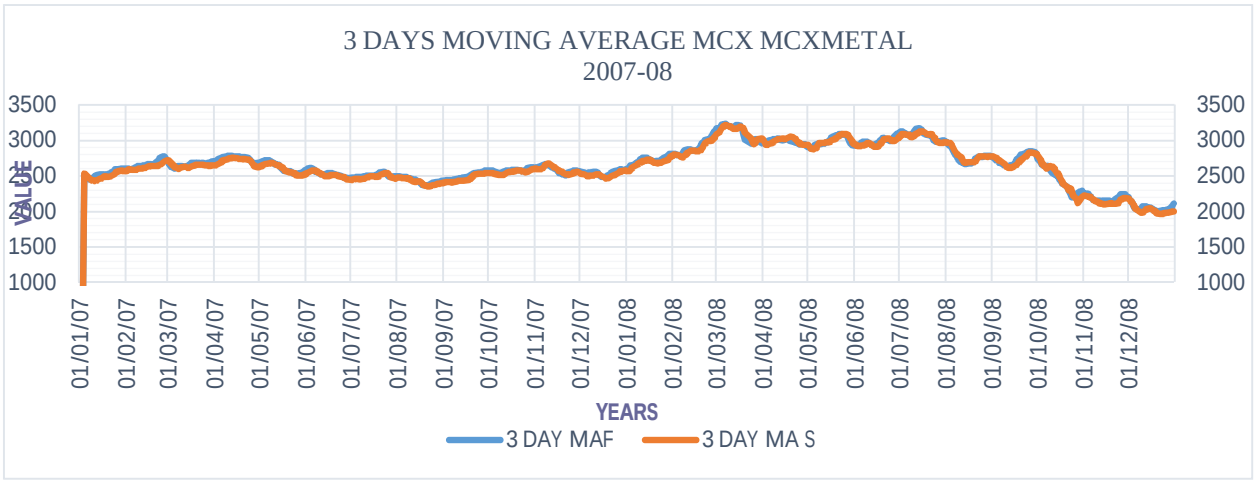
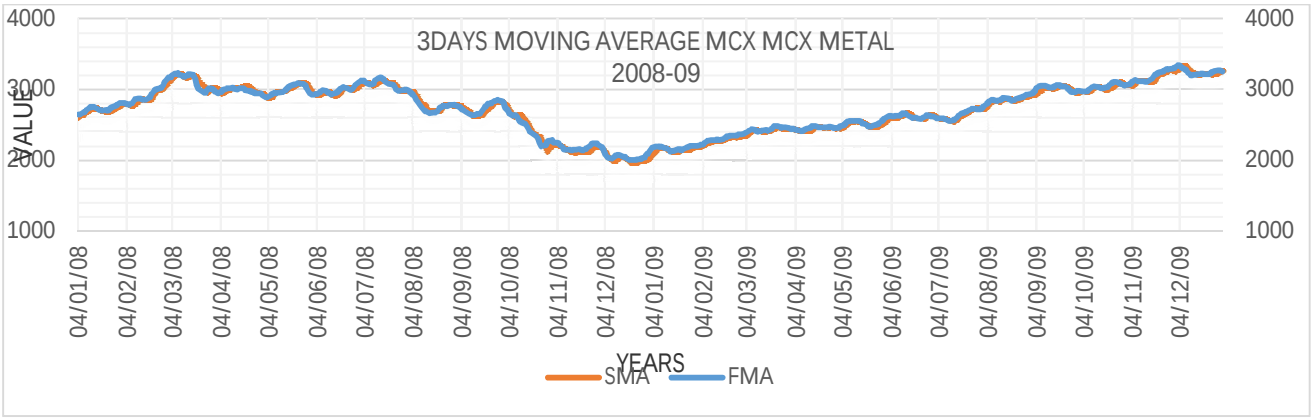
CHART- 3



Source: calculated from the MCXMETAL data from www.mcxindia.com

From chart 3 it is observed that futures leads the spot more number of times whereas spot could not able to lead the Futures therefore we can conclude that both are markets are moving in the same track with slim deviation.

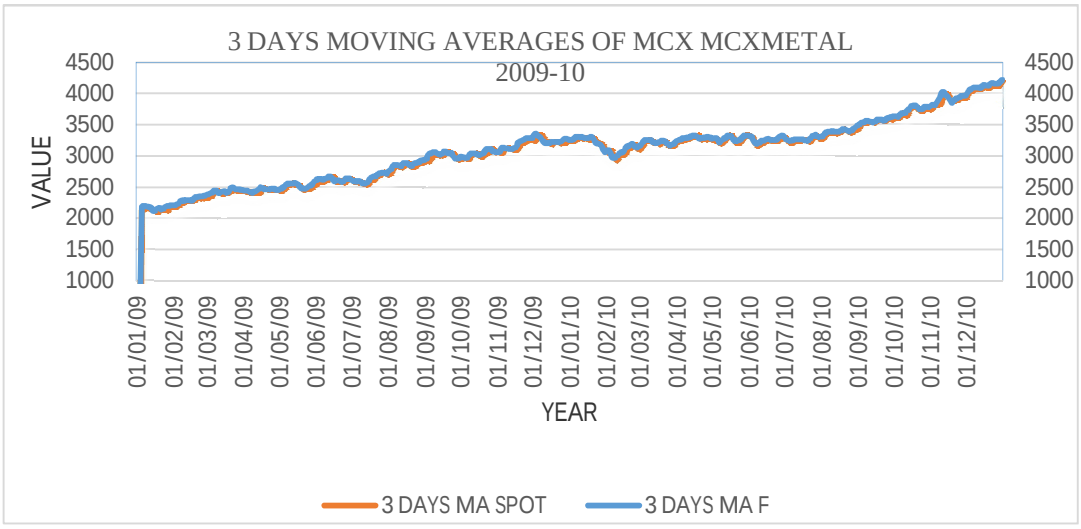
CHART - 4



Source: calculated from the MCXMETAL data from www.mcxindia.com

From the above chart 4 it is seen that very few time the spot prices are marginally outperforming the Futures prices whereas the Futures are playing the lead role in this year also.

CHART - 5



Source: calculated from the MCXMETAL data from www.mcxindia.com

From the above chart 5 it is seen that Futures prices are leading the spot prices whereas spot prices in the two years did not even single time outperform the Futures prices.

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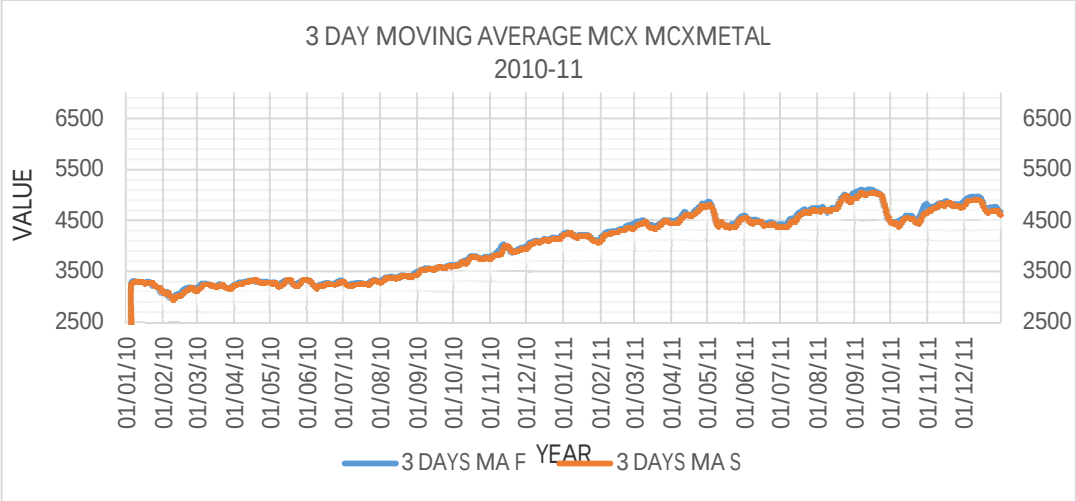
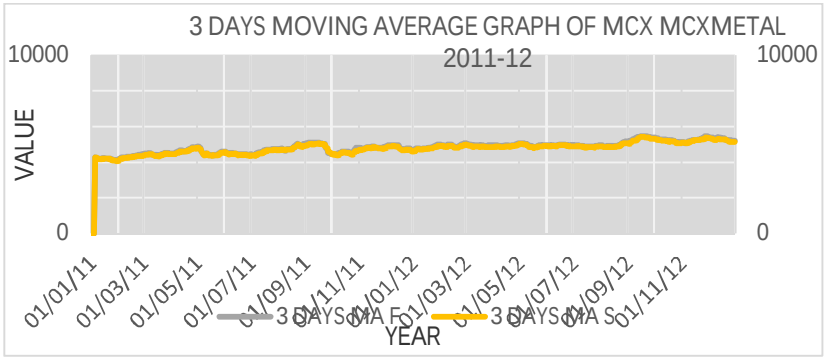
CHART - 6



Source: calculated from the MCXMETAL data from www.mcxindia.co

According to the above chart it can be cleared that all the year 2010-11 have witness the Futures price domination when compare to spot prices.

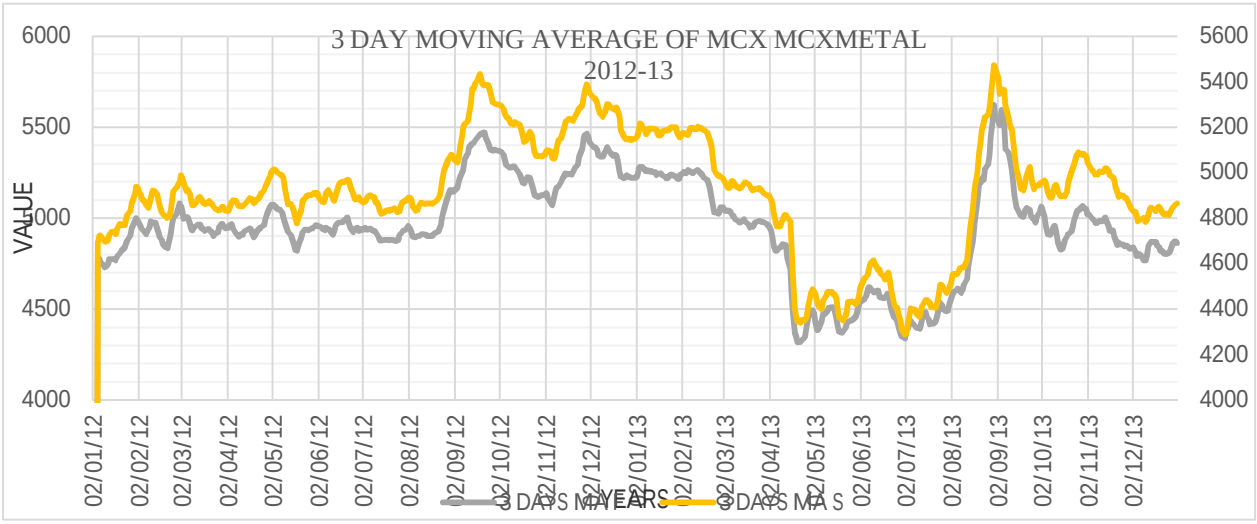
CHART - 7



Source: calculated from the MCXMETAL data from www.mcxindia.com

According to the above chart it can be cleared that by and large, Futures moved ahead of spot,the market moved closely together with a narrow basis.

CHART - 8



According to the above chart it can be cleared that by and large, Spot moved ahead of Future, the market moved closely together with a narrow basis.

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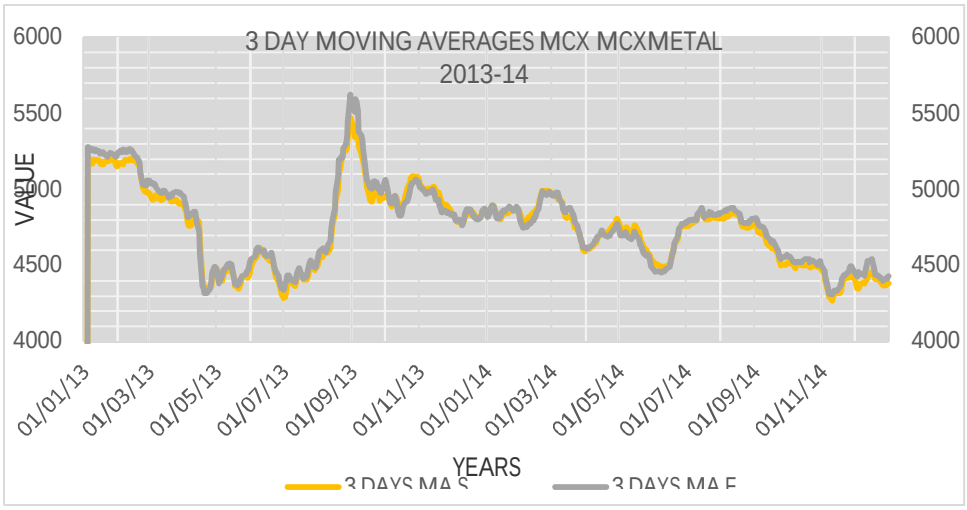
CHART - 9

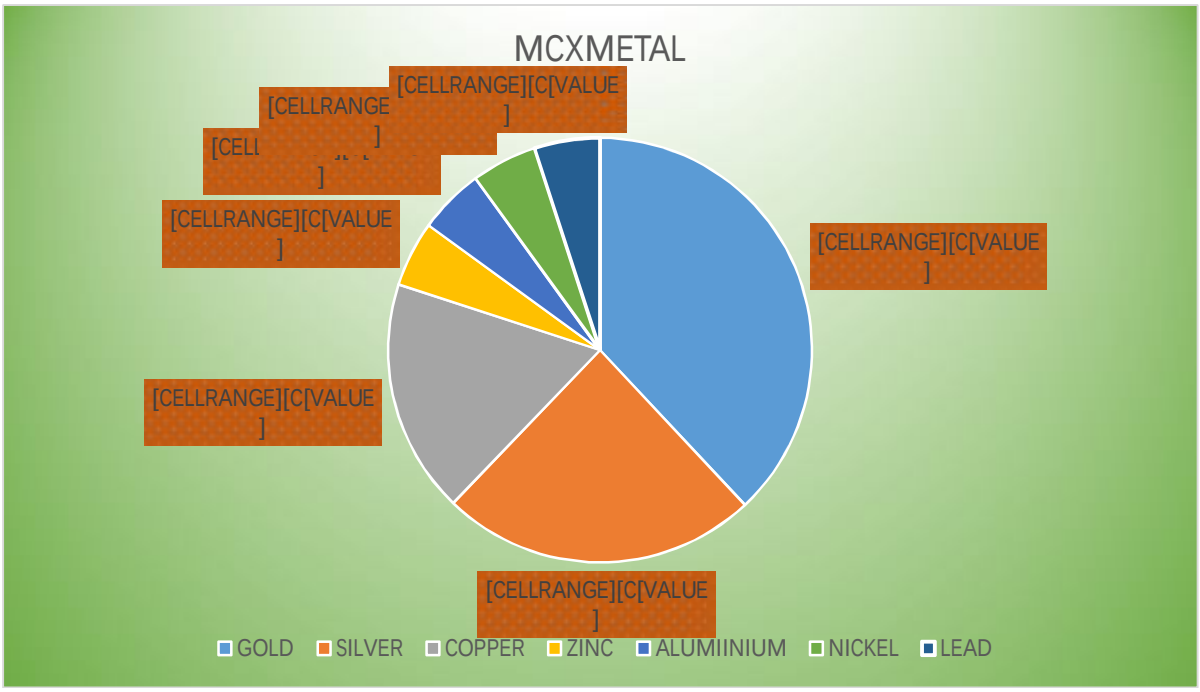


From chart 8 it is clearly seen that by and large, Futures moved ahead of spot the market moved closely together with a narrow basis.

Mcxmetal structure

GOLD	15.21%
SILVER	9.66%
COPPER	7.13%
ZINC	2.00%
ALUMIIINIUM	2.00%
NICKEL	2.00%
LEAD	2.00%

Source www.mcxindia.com



Source wwww.mcxindia.com

Correlation between Futures prices and Spot prices (percentage)

2005	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13
97	97	98	99	100	100	99	98

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Regression Analysis Futures prices and Spot prices where Y (spot) is Independent and X (Future) is independent

2005	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13
0.97	0.97	0.98	0.98	0.99	0.99	0.99	0.98

From table 1 it is clearly seen the perfect positive correlation between the Spot and Futures price all the years from 2005 till 2014,and from table 2 Regression Analysis shows that Futures prices are dependent on spot prices.

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GENDER THERAPY- A LATEST TREND TO SOLVE SOCIAL ISSUES

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Recent time is witnessing increasing violence in an almost indiscriminate manner. In most cases these are directed towards women and children and are taking the forms of sexual abuse, harassment, rape and consequent murder. Today, media are turbulent with the news of the rape and physical assault of a 70 year old Christian Nun in Ranaghat, West Bengal, who resisted a robbery in the institute she works and stays in. Just before that issue much criticism was directed towards Leslee Udwin who directed India's Daughter, a documentary film and is part of the BBC's ongoing Story Ville series. The film is based on the 2012 Delhi gang rape and murder of a 23-year-old woman who was a physiotherapy student. In the movie, one of the convicted rapists serving life imprisonment, Mukesh Singh, was interviewed for the documentary. He said in the interview "When being raped, she shouldn't fight back. She should just be silent and allow the rape. Then they'd have dropped her off after 'doing her', and only hit the boy." He later added, "A girl is far more responsible for rape than a boy … A decent girl won't roam around at nine o'clock at night … Housework and housekeeping is for girls, not roaming in discos and bars at night doing wrong things, wearing wrong clothes." A report by the Navbharat Times has suggested that Mukesh Singh was paid 40,000 (about GB£420) to do the interview. According to the report, initially he had asked for 200,000, but the amount was negotiated down and the sum was given to his family. However, the film maker denies that he was paid for the interview.

A.P. Singh, a defence lawyer in the case, was shown saying, "If my daughter or sister engaged in pre-marital activities and disgraced herself and allowed herself to lose face and character by doing such things, I would most certainly take this sort of sister or daughter to my farmhouse, and in front of my entire family, I would put petrol on her and set her alight." Asked later if he stood by those comments, he insisted that he did.
These incidents arouse many social, political and cultural issues; have given birth to too much controversies and debate. Oppression over women had never been so nude and ugly in published news. However, a student of psychology would like to search for such attitudes towards a woman's status in so called 'civilized' society in the factors much deeper. Before the search begins it is necessary to clarify some of the constructs related to the issue.

GENDER - A SCHEMA AND A STEREOTYPE

According to American Psychological Association (2007) 'Gender' refers to 'psychological, social and cultural experiences and characteristics associated with the biological aspects of being female or male'.

According to Women's Commission for Refugee Women and Children in New York (2005) Gender roles and expectations are learned. They can change over time and they vary within and between cultures. Systems of social differentiation, such as political status, class, ethnicity, physical and mental disability, age and more, modify gender roles. The concept of gender is vital because, applied to social analysis; it reveals how women's subordination (or men's domination) is socially constructed. As such, the subordination can be changed or ended. It is not biologically predetermined nor is it fixed forever (Definition from UNESCO's Gender Mainstreaming Implementation Framework, Baseline definitions of key concepts and terms, April 2003.) .

A gender schema is a cognitive structure consisting of a network of associations that organize and guide an individual's sex-linked perceptions.

Sex-typing derives in part from 'a generalized readiness to process information on the basis of sex-linked information that constitute gender schema' (1981).

CONSTRUCTION OF MALE ROLE

As discussed above, gendered norms and behaviors are taught and learned rather than being natural or genetic. Though each societal construct of masculinity varies over time and according to culture, age and position within society, all men share a common thing---- gender privilege. By virtue of being born male, men are granted access to power, position and resources on a preferential basis to women. This is often taken for granted, assumed and seldom earned. Cultural norms about gender roles are "delivered" to a child by the family, the peer group and the community. Young boys, for example, are generally allowed more freedoms and have fewer restrictions placed on them than young girls. They are taught to play rough, to stand up for themselves, not to walk away from a fight. They run out to play while their sisters are kept indoors to care for younger children and to help with domestic chores.

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At an early age many boys learn that they must be strong, they must not show their feelings, and that conflict is resolved by physical violence and sometimes even that boys are superior to girls. This socialization can lead boys and men to feeling justified in subordinating women and girls.

As boys grow up, they often have priority access to higher education, especially if the family can afford to send only one child to school or college. They generally receive better jobs, or the same jobs at better pay. As adults, men are taught to define themselves by their career success.

Men and boys are, in most cultures, socialized to be competitive, aggressive and dominant.

Political and economic power are valued and rewarded. Physically and financially powerful men are viewed as desirable by women and enviable by other men. Men are also, at times, socialized to be sexually promiscuous, even sexually irresponsible.

Men are socialized into their gender roles and pressured to follow rules about how a man should think, feel and act. Men are urged to excel. They are supposed to grow up to be powerful and not to show weakness; they are preferred, valued and encouraged more and prepared better for careers than are females. They are expected to be independent, demanding and aggressive.

Aggressive behavior, as an example, is reinforced and glorified by the violence in movies, sports and the military. The male heroes are generally strong, tough, often superhuman and ultra macho.

CHANGE IN MALE ROLES-------FACTORS AND CONSEQUENCES

Feminist movements portrayed women as victims and men as persecutors. Sometimes it is claimed that this over generalized insensitivity may damage boys and men's self esteem and hinder the development of mutually respectful men-women relationship.

O'Neill and his colleagues (1986) developed a Gender Role Conflict Scale (GRCS) that identified four gender role conflict patterns of factors, namely, i) Success, power and competition ii) Restrictive emotionality iii) Restrictive affectionate behaviour between men and iv) conflict between work and family relations.

The underlying idea behind the GRCS is that the process of male socialization creates conflict, stress and anxiety for men when they deviate from masculine ideals. Studies (Good et al., 1996) suggest that gender role conflict is associated with higher levels of depression, interpersonal sensitivity, predicted paranoia, psychoticism and obsessive compulsivity.

Further, in a comparative study of non clinical samples of college aged and middle aged men, it is found that middle aged men were less conflicted about success, power and competition, but were more conflicted between family and work responsibilities (Cournoyer and Mahalik, 1995). Studies also illustrate that wanting to deviate from traditional masculine roles often comes at a psychological price.

Though largely formulated by men, perhaps existing counselling and therapy approaches are insufficiently sensitive to men's as well as women's experience and issues. Regarding life span problems, men do not have the kind of problems that women do, for instance going through the menopause. On the other hand men's life expectancy is on average five years lower than women. Biddulph (2003) observed that American men exceed women in thirteen leading causes of death, be it a car accident, heart attack or liver disease.

Nelson –Jones (2012) has pointed out several psychological problems beset boys and men: for example behavioural problems in school, hurt stemming from absent or neglectful fathers-----sometimes called 'father hunger' work related stress, alcoholism, being physically violent, pressure to initiate relationships with opposite sex, pressure to perform sexually (men cannot fake erections), difficulty showing tender feelings and vulnerability, insufficient preparation for fatherhood, insufficient intimacy with same sex friends, pressure to be financially successful, loss of identity through unemployment and loss of contact with children after a relationship break up. Many men are challenged to adjust to the changes brought about in their partners by the women's movement. Women easily outnumber men as clients in therapy. This imbalance indicates that another problem for men by their greater unwillingness to admit to problems and seek psychological assistance when experiencing difficulties themselves and creating difficulties for others.

Recently, awareness is growing about daily gender related issues in the process of psychotherapy. It is found, now-a-days; numerous men remain at low levels of awareness about the effects of gender conditioning on their psychological well being.

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GENDER THERAPY ---- GENERAL GOALS

General goals of Gender Therapy are similar to any other therapeutic process. They include helping individual clients use their strength and potential, make appropriate choices, remedy poor skills and develop positive and flexible self concepts. In addition, therapeutic goals relating to gender roles an often involve both male/female partners: for example, learning to deal with demand/withdraw interaction pattern in marital conflict(Christensen and Heavy, 1993) and handling the numerous issues confronting dual-career couples in a time of rapid technological and economic change(Fallon, 1997; Serlin, 1989).

Since the focus of this article is to question the role a man plays in indiscrete violence and in degrading women with an intense hatred, goals and issues related to male role will be highlighted in the discussion.

THERAPEUTIC GOALS FOR MEN----BREAKING THE BARRIER

Since considerably fewer men than women come for therapy, one broader goal may be to increase the number of men prepared to address their gender role and other problems in therapy.

Men, like women, need to free themselves from limiting gender role stereotypes and develop more of their unique potential.

Another therapeutic goal would be, where appropriate, to make men aware of the extent to which their thoughts, feelings and behaviours have been and continued to be heavily determined by their past and current gender role socialization.

Other therapeutic goals for men clients include stopping being physically violent both inside and outside home, dealing with work related stress, overcoming tendencies to treat women as sexual objects, dealing constructively with homosexuality and bisexuality and developing better health care skills.

It is essential to put men in positions of exploring, understanding and altering their own gender roles. Positive maleness, combining tenderness and toughness and treating women with respect as equals, is a desirable outcome from this process. Boy and men are likely to be more constructive and caring if assisted to become confident in manhood rather seeking to prove themselves all the time by pretending to be what they are not.

GENDER THERAPY FOR WOMEN-------OTHER SIDE OF THE COIN

While highlighting issues related to male role and conflicts, a psychologist as a social scientist cannot and must not overlook the issues and conflicts related to female role as well. It cannot be denied that socialization at its early and crudest form begins in home, in the arms of a caregiver, who is almost always a woman. A boy child or a girl learns his or her first lesson to look at oneself and others coloured with gender, along with many other cultural parameters. It is equally essential that a woman must learn to respect herself as an individual and neither as a victim of oppression nor as a helpless and demure wall flower. Assertiveness training, gender role analysis and consciousness raising are some of the therapeutic needs for women. According to Chaplin (1999) therapeutic goals of women should be directed towards building self esteem and sense of control over their lives.

Feminist therapy based on Chaplin's (1999) 'cognitive feminism' approach stresses feminine rhythm model. In the rhythm model there is flow and balancing between extremes, for instance alternating between joy and sorrow throughout a day. Each client needs to find her own unique rhythms and balancing between her 'active' and resting sides, her 'private' and 'public' sides, and her 'self expression' and 'caring for others' side.

Five central principles of feminist therapy (Ballou, 1996; Cheatham et al., 1997)are as follows:

1) **Egalitarian relationships** related to fair distribution of power to both the genders.
2) **Pluralism**, which is an acknowledgement and giving value to individual differences and diversities between genders and showing respect to it.
3) **Working against all forms of oppression**, for instance, on the basis of sex, sexual orientation, race, culture, religious belief, lifestyle choice and physical disability.
4) **Emphasis on external factors** such as social/ political/economic structures for shaping women's values and self concept.
5) **Relying on the actual experiences** of women for description of 'reality' rather than interpreting those experiences based on a general, often male dominated behaviour.

RETURNING TO THE "WORLD OF MEN"

Greer (1999) was of opinion that virtually all of the negative behaviours towards woman are symptomatic of men's psychological wounds and insufficient personal development rather than their innate badness. Unfortunately, the behaviour of some wounded men, for instance gang rape and post rape violence on "Nirbhaya" do little to generate sympathy for their underlying suffering and low self esteem. Nonetheless, current literature show an increasing awareness on men's issues focusing on negative aspects of men's behaviour changing, such as curbing domestic violence and sexual abuse. Recent articles in counselling and therapy books (Biddulph, 2003) advocate positive maleness and how to achieve it.

Men's therapy can be conducted both on an individual basis, in men's groups and as a part of working with couples and families. In addition, sometimes, both men's and women's issues are addressed in mixed groups.

In sum, men's movement and men's therapy can be viewed as complimentary to feminist movement and feminist therapy.

EPILOGUE

No idea, philosophy theory and practice are free from follies. There are benefits as well as risks in focusing on gender role issues. The benefits include a lessening of sexist oppression, a greater chance for people to develop their full human potential rather than lead lives constricted by gender role stereotypes, and greater attention paid to developing interventions for the specific problems that beset sex.

As for risks, changing current balance of gender roles may lead to people's selfishness in already highly individualistic western culture.

Both men and women may sacrifice communal values, and possibly the welfare of children too, in the interests of their own individual development.

However, feminist therapy redresses the neglected issue of insufficient gender role socialization. There is still considerable scope for originating new counselling and therapy approaches as well as for modifying existing ones, to promote equality between the sexes and to liberate girls, women, boys and men to become more fully human.

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COMMODITY DERIVATIVE WITH SPECIAL REFERENCE TO MCXINDEX

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ABSTRACT

The trading in commodities was started with the first transaction that took place between two individuals. We can relate this to the ancient method of trading i.e., BARTER SYSTEM. This method faced the initial hiccups due to the problems like: store of value, medium of exchange, deferred payment, measure of wealth etc. This led to the invention of MONEY. As the market started to expand, the problem of scarcity piled up .The farmers / traders then felt the need to protect themselves against the fluctuations in the price for their produce. In the ancient times, the commodities traded were – the Agricultural Produce, which was exposed to higher risk i.e., the natural calamities and had to face the price uncertainty. It was certain that during the scarcity, the farmer, realized higher prices and during the oversupply he had to loose his profitability. On the other hand, the trader had to pay higher price during the scarcity and vice versa. It was at this time that both joined hands and entered into a contract for the trade i.e., delivery of the produce after the harvest, for a price decided earlier. By this both had reduced the future uncertainty. In this paper an attempt has been made to track the volatility analysis of some commodity derivatives on the basis of empirical finding of 4 years future prices of select commodities: - Gold& Silver. A volatility analysis of these two precious metal commodity have been carried out in this paper.

KEYWORDS: *commodity gold derivatives, futures trading, volatility, Gold demand, Gold supply, performance of Gold.*

INTRODUCTION

The Indian experience in commodity futures market dates back to thousands of years. References to such markets in India appear in 'Kautialyas,'Arthasastra'. The words, 'Teji', 'Mandi', 'Gali', and 'Phatak' have been commonly heard in Indian markets for centuries. Derivatives is useful for reducing many of the risks history of financial markets has evidence to suggest that when risk management avenues are provided by means of derivatives, markets attract higher volumes of investments from savers, strengthening the markets in the process. Derivatives plays a variety of roles but, perhaps, the most important role is hedging Involves transfer of market risk-the possibility of sustaining losses due to unforeseen unfavorable price changes. A derivatives trading allows an investors to alter his market risk profile by transferring to counter-party some type of risk for a price. Hedging is the prime reason for the advent of derivatives and continues to be a significant factor driving investors to deal in derivatives. Derivatives products serve the vitally important economic functions of price discovery and risk management. The transparency, which emerges from their trading mechanism, ensures the discovery in the underlying market. Further, they serve as risk management tools by facilitating the trading of risks and get rid of undesirable undertones. To facilitate the development of derivatives market, it is necessary to educate the market participants /investors on the hints of these new age products and their strategic use. In this regards, the role of SEBI, stock exchanges and its member participants is very much needed. To keep speed with inevitable and persistent uncertainty, today's investors must understand the basics of derivatives. Derivatives serve as tools for managing risk when used judiciously and cautiously.

EVOLUTION OF COMMODITY MARKET IN INDIA

Derivatives markets in India have been in existence in one form or the other for a long time. In the area of commodities, the Bombay Cotton Trade Association started futures trading way back in 1875. In 1952, the Government of India banned cash settlement and options trading. Derivatives trading shifted to informal forwards markets. In recent years, government policy has shifted in favor of an increased role of market-based pricing and less suspicious derivatives trading. The first step towards introduction of financial derivatives trading in India was the promulgation of the Securities Laws (Amendment) Ordinance, 1995. It provided for withdrawal of prohibition on options in securities. The last decade, beginning the year 2000, saw lifting of ban on futures trading in many commodities. Around the same Period, national electronic commodity exchanges were also set up. Derivatives trading commenced in India in June 2000 after SEBI granted the final approval to this effect in May 2001 on the recommendation of L. C Gupta committee. Securities and Exchange Board of India (SEBI) permitted the derivative segments of two stock exchanges, NSE and BSE, and their clearing house/corporation to commence trading and settlement in approved derivatives contracts. Initially, SEBI approved trading in index futures contracts based on various stock market indices such as, S&P CNX, Nifty and Sensex. Subsequently, index-based trading was permitted in options as well as individual securities. The trading in BSE Sensex options commenced on June 4, 2001 and the trading in options on individual securities commenced in July 2001. Futures contracts on individual stocks were launched in November 2001. The derivatives trading on NSE commenced with S&P CNX Nifty Index futures on June 12, 2000. The trading in index options commenced on June 4, 2001 and trading in options on individual securities commenced on July 2, 2001.

Single stock futures were launched on November 9, 2001. The index futures and options contract on NSE are based on S&P CNX. In June 2003, NSE introduced Interest Rate Futures which were subsequently banned due to pricing issue.

TABLE 1 GLOBAL GOLD SUPPLY &INDIA DEMAND FOR GOLD

Year	Global Gold Supply $ (Tonnes)	Demand from India @ (Tonnes)	Growth of Global Gold Supply	Growth of Global Gold Supply
2009	4146	743	13.4	9.4
2010	4274	871	3.1	17.4
2011	4030	975	-5.7	11.9
2012	4130	1079	2.5	10.7
2013	4339	3756	-	-

Source: World gold council & estimations from DGCI&S; Data; calendar year;@ financial year

OBJECTIVES OF STUDY

1) To study the growth of commodity derivatives in India during last three years (i.e. from 1st March 2011 to 28th February 2014.

2) To study and analyze the performance of commodity derivatives in selected commodities traded by MCX in India.

REVIEW OF LITERATURE

Harwinder et.al(2013): According to his analysis there is drastic change in the commodity futures market since its inception in terms of volume of trade and numerous product combination available for the investors .According to him commodity futures market playing two very important functions of the economy the first one is the price discovery and risk management, which again provides the liquidity and help in hedging future price risk. Secondly it further develop the field of electronic warehouse receipt which definitely proof to be commodity market the strengthen the Indian economy.

Mc Kenzie and Hot (2002): They are of the opinion that the future market is unbiased in the long run and in the short run it is inefficient and price-biased.

Gopal and sudir (2001): according to the study they have divided the market into efficient and inefficient market. Efficient market in terms of price risk management and the reasons for

inefficiency of other commodity market were found inefficient due to low volume of trading during maturity period and lack of hedgers participation.

Jensen at al. (2002) find that commodity futures substantially enhance portfolio performance for investors, and show that the benefits of adding commodity futures Overall, their findings indicate that investors should gauge monetary conditions to determine the optimal allocation of commodity futures within a portfolio.

Draper et al. (2006) examine the investment role of precious metals in financial markets using daily data for gold, platinum, and silver. They show that all three precious metals have low correlations with stock index returns, which suggests that these metals may provide diversification within broad investment portfolios. They also show that all three precious metals have hedging capability for playing the role of safe havens, particularly during periods of abnormal stock market volatility.

Mc Cown and Zimmerman, 2006:They are of the opinion that gold has the characteristics of a Zero-beta assest that has the ability to hedge against inflation.

Hammoudeh and Yuan (2008) apply univariate GARCH models to investigate the volatility properties of two precious metals, gold and silver, and one base metal, copper. They found in the standard univariate GARCH model that gold and silver had almost the same volatility persistence, while the persistence was higher for the pro-cyclical copper.

Conover et al. (2009) present new evidence on the benefits of adding precious metals (gold, silver and platinum) to U.S. equity portfolios. They find that adding a 25% metals allocation to the equities of precious metals firms improves portfolio performance substantially, and that gold relative to platinum and silver has a better stand-alone performance and appears to provide a better hedge against the negative effects of inflationary pressures. They also show that while the benefits of adding precious metals to an investment portfolio varied somewhat over time, they prevailed throughout much of the 34-year period.

Khalifa et al. (2010) variability plays a critical role in the analysis of financial markets. They estimate different measures of volatility for gold, silver and copper. They find that the return distributions of the three markets are not normal and the application of financial time sampling techniques is helpful in obtaining a normal distribution. Using the autoregressive distributed lag approach.

Sari et al. (2010) examine the co-movements and information transmission among the spot prices of precious metals (gold, silver, platinum, etc,).They find evidence of a weak long-run equilibrium relationship, but strong feedbacks in the shortrun. They conclude that investors may diversify a portion of the risk by investing in precious metals, oil, and the euro.

Hammoudeh et al. (2010) examined the conditional volatility and correlation dependence and interdependence of four major precious metals (gold, silver, platinum and palladium), The results indicate significant short-run and long-run dependencies and interdependencies to news and past volatility. The empirical results become more pervasive when exchange rate and federal funds rate are included.

Baur and Lucey (2010) examine relations between international stocks, bonds and gold returns to evaluate gold as a hedge and a safe haven. They find that gold is a hedge against stocks, on average, and a safe haven in extreme stock market conditions. Prices of precious metals have been highly volatile in the past, and even more so recently. The volatile precious metal price environment requires risk quantification.

Parabutra and chaibetphon (2010): They are the first Indian to study the price discovery in India, They examines the standard futures contract and mini contracts for the gold prices in Multi commodity stock exchange, they have come to a conclusion that the futures prices of both standard and mini contracts lead spot prices. The mini futures contracts account to 30% of price discovery even though the trading volume represents only 2% on the MCX.

C.Mitchell et.al (2007): There finding from a 34 year study period support the claim that the investment benefits are considerably larger if the exposure to precious metal is obtained indirectly via an investment in the equities of precious metals firms, rather than directly by purchasing the precious metal as Gold.

RESEARCH METHODOLOGY

The following methodology has been adopted.

I) RESEARCH DESIGN

The proposed work is based on empirical study and the research is descriptive and explanatory in nature.

II) DATA COLLECTION

The secondary data has been collected from authentic websites of mcx. The closing future price of the commodity under observation has been taken.

III) METHOD TO COMPUTE VOLATILITY

Since the study is based on secondary resources of information and data relating closing future price of GOLD for the last three years, the following mathematical and statistical tools have been applied to calculate volatility of metal Derivatives i.e Gold,silver,copper.

HISTORICAL VOLATILITY: This is a measure of how volatile the underlying futures contracts has been for the (3 years) i.e each year consist of 252 trading days prior to each observation date in the data series. It is an annualized standard deviation of price changes expressed as a percentage.S

STEPS USED IN CALCULATION OF VOLATILITY IN MS-EXCEL

Calculations: Historical Volatility (24-Day):

STEP1: Calculate today’s close / previous close(price change)

STEP2: Calculate the natural log (In) of the results calculated in STEP 1.

STEP3: Calculate the sum of the natural logs over the past days. Calculate the sum of the squares of the natural logs over the past days.

STEP4: Divide the sum of the natural logs by 24 Divide the sum of the squares of the natural logs by 24 Calculate: RESULT 2 - the square of RESULT 1 Calculate the (square root of RESULT 3) x (sq. root of 252) x 100 this is the 24-day historic volatility for today.

V) SCOPE OF THE STUDY

There are various indices of commodity are available like MCX COMDEX , MCX METAL MCX ENERGY,MCX AGRI rainfall etc. for better comparison and analysis only MCXMETAL have been taken in the analysis. i.e. 2011-2014 only for three years. Under commodity derivatives forward, future, option and swap many other, are available but focus of this research is on the future commodity prices. A number of commodities which traded at MCX such as future commodity derivatives like Agro-based Commodities, Soft Commodities, Live Stock, Energy, Precious Metals etc. here for making an analysis bullion commodity such as GOLD SILVER COPPER commodities have been selected.

ANALYSIS AND INTERPRETATION

A study of volatility of future prices of selected metals has been carried out as per the result shown in following tables.

TABLE 2: PRESENT COMPOSITION OF COMMODITIES AND THEIR WEIGHTS IN THE MCXMETAL

No.	Commodity MCX-METAL	Weight(New)
1	Gold	15.21%
2	Silver	9.66%
3	Copper	7.13%

Source: www.mcx.com

From the above table it is clear that Gold is having more weight in MCX metal in comparison with other two metal i.e. gold and silver it can be concluded that Gold is more important than silver and copper in mcxmetal index.

TABLE 3 SHOWING YEARLY VOLATILITY OF MCXMETAL INDEX ON THE BASIS OF THREE YEARS DATA I.E.1-1-2011 TO 31-12-2013

Year	**Volatility**
2011-12	24.53
2012-13	13.38
2013-14	39.89

Source: Based on calculation from MSEXCEL

TABLE 4 SHOWING THREE YEARS VOLATILITY OF MCXMETAL INDEX ON THE BASIS OF THREE YEARS DATA I.E 1-3-2011 TO 1-3-2014

MCX METAL	**2011 TO 2013**
Volatility of Index	25.93

TABLE 5 SHOWING YEARLY VOLATILITY OF SELECTED BULLION COMMODITIES FUTURE PRICE

Name of commodity	**Contract 1**	**Contract2**	**Contract 3**
Gold	1-10-2011 to 5-2-2011 19.74	5-10-2012 to 4-2-2012 12.62	5-10-2013 to 5-2-2013 33.19
Silver	5-12-2011 to 5-3-2011 64.42	5-12-2012 to 5-3-2012 52.06	5-12-2013 to 4-5-2013 37.6
Copper	30-8-2011 to 28-2-2011 12.51	30-8-2012 to 29-2-2012 19.45	30-8-2013 to 282-2013 19.21

Source: Based on calculation from MSEXCEL

From the analysis of table 4 and 5 it is clear that the volatility of all three metal i.e. GOLD, SILVER & COPPER understudy can be interpreted as follows Gold was showing continuous decreasing in all the contacts compared to standards i.e. the benchmark. Silver is showing higher than the benchmark index MCXMETAL for two years i.e. 2011 to 2012 but 2013, the volatility in the year has been lower than the volatility of MCXMETAL index in Copper also showing decline in 11 and 13 but increased in 12.One more conclusion have been carried out from table 5

that the gold is less volatile in all three contract in comparison of silver and copper. Copper is more volatile in comparison of gold and silver.

TABLE 6: SHOWING SIX MONTHLY VOLATILITY MCXMETAL INDEX ON THE BASIS OF THREE YEARS DATA I.E.1-3-2011 TO 28-02-2014

Time-period	Volatility
1-3-11 to 31-8-11	26.29717
1-9-11 to 28-2-12	28.02762
1-3-12 to 31-8-12	11.71012
1-9-12 to 28-2-13	16.04772
1-3-13 to 31-8-13	23.78108
1-9-13 to 28-2-14	20.03178

Also from table 6 it is evident that the volatility of benchmark MCXMETAL index has been quite higher from six month period of 1-9-11 to 28-2-12 i.e. almost 39%. Then it has shown declining trend in 2012. After that up to 2013 it has shown increasing trend. In the conclusion we can say that after 2012 the specification is more volatile and the volatile behavior of metal has beaten the yardstick.

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